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## ORIGINAL MEMOIRS.

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### THE CONTROL OF BLEEDING IN OPERATIONS FOR BRAIN TUMORS.\*

WITH THE DESCRIPTION OF SILVER "CLIPS" FOR THE OCCLUSION OF VESSELS  
INACCESSIBLE TO THE LIGATURE.

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ALL surgeons who make for themselves opportunities to observe the manipulative work of their fellows must appreciate the present general tendency toward the abandonment of the applauded methods of comparatively few years ago. The conditions under which Cooper, Pott, and Abernethy worked have long since changed, and though the by-the-clock methods which were essential to operative success in their day are still emulated in some of our present clinics, the stirring, slap-dash, and spectacular is rapidly giving way to the quiet, patient, and undramatic performance.

The elimination of pain has made hurry unnecessary; due respect for the principles which have grown from Listerism has made it inadvisable; the emphasis laid by Halsted on detailed blood-stilling during major operations has proved a further check, and lastly, an expectation of the reactionless healing which occurs only in tissues handled with the greatest delicacy and coapted with scrupulous care is prohibitive of

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haste and the old-time thrills for the bystander which accompanied it.

There are special reasons why the utmost precaution in anæsthetization, the gentlest methods of handling tissues, and the most accurate closure of wounds, accompanied by as pain-taking hæmostasis as possible, should be observed during the more difficult intracranial procedures. Neighborhood oozing obscures the clear view essential to the safety of such delicate manipulations as are required for the removal of, let us say, a lateral recess tumor or the trigeminal ganglion; whereas a more general loss of blood with the consequent lowering of arterial tension is a cordial invitation to its near relative shock, favors the onset of respiratory paralysis in cases associated with medullary pressure, makes anæsthesia more dangerous, and lowers resistance to infection through secondary anæmia.

These are premises, I am aware, which are not accepted by all surgeons, for many still feel that high-gearred methods of operating can outdistance these largely imaginary risks, and there is a wide-spread apprehension lest observation of these minutiae engender a reputation of being a slow and fussy surgeon. For, after all, what do these details amount to, with another patient awaiting his turn and an assistant who can close the wound, put on the dressing, and administer stimulants and infusions. But for those who grant the premises and agree that every effort should be made, even at the expense of time, to respect the tissues and to minimize the loss of blood by whatsoever methods one can summon to his aid, there are certain "tricks" which may be found useful, particularly in cerebral surgery.

It is necessary to bear in mind that two fairly distinct vascular systems will be encountered—internal and external. On the arterial or carotid side these systems are quite distinct, but on the venous side the communications between them are so free that, under conditions of intracranial stasis brought about by a growth producing an increase of tension, the venous return from the internal system is in large part shunted into the extracranial field. For this reason—though the

"tricks" to be spoken of apply chiefly to the internal system of vessels with a cerebral and meningeal distribution—it may not be out of place to preface a few remarks concerning ways of combating loss of blood from the external coverings, through which the approach to the more important structures must be made.

Throughout this paper the more critical cases will be considered. If precautions are taken to meet the serious problems of hæmostasis which the critical cases present, the simpler and less complicated ones can be more often carried through to a successful termination at one sitting. Furthermore, the discussion will be largely restricted to the osteoplastic type of operation on the cranial vault; for if its principles are mastered, operations in situations which forbid the use of a tourniquet or those in which a bone flap is prohibited may be conducted with comparative ease.

*The Scalp.*—That a trifling wound in a normally vascularized scalp may bleed abundantly is familiar enough. But when stasis of the extracranial vessels has been produced by a cerebral tumor, the loss of blood incidental to the long incision needed for an osteoplastic resection may be disproportionately excessive, unless precautionary measures are taken. Many devices have been suggested to control bleeding from the scalp, none of them in the long run being as efficient as a properly applied tourniquet. This, in any event, will control the arterial supply to the operative field, and if there is no cyanosis under the anæsthetic and no unusual widening of the emissary venous communications between the internal and external systems, not a single hæmostatic adjunct may be required. When, on the other hand, venous stasis has long existed and wide communications have formed between extra- and intracranial veins, the scalp will fill with blood and require the placement of clamps, no matter what device be employed. But even under these circumstances, the convex side of the incision towards the flap remains dry—a desirable result, as it avoids the risk of stripping scalp from bone through the weight of pendent instruments. When it is necessary to place

clamps on the concave edge, even though the bleeding points may lie in the tough scalp proper, it is best to catch the galea and allow the mere weight of the clamps to close the bleeding points. This precaution will avoid superficial points of tissue necrosis which militate against the subsequent reactionless healing. The flat T-shaped clamps which have been devised for the scalp are, I think, undesirable, for the reason that they are difficult to place and are likely to damage the tissues.

As many of these more desperate cranial operations must require two or more stages before their end, it is essential that the utmost pains be taken in closing the wound to assure an epithelial approximation which will permit early removal of the external sutures. Needless to say, if there are points of staphylococcal stitch infection, or even granulating edges owing to inaccurate closure, the reopening of the wound after a few days, and possibly the later re-reopening after a subsequent interval, is accompanied by especial risks of infection.

Our local method of closing these wounds is to bring the edges of the galea together by a series of interrupted and buried fine black (iron-dyed) silk sutures. This row of buried sutures oftentimes so closely approximates the overlying tough scalp as to render the placement of cutaneous sutures hardly necessary, were it not for the fact that they are destined to control the arterial bleeding which would otherwise ensue on the final removal of the tourniquet. A satisfactory method of placing these sutures before they are tied, by a row of round, fine intestinal (cambric) needles, has heretofore been described.<sup>1</sup> They should be removed after thirty-six or forty-eight hours; and by the fourth or fifth day the incision is hardly visible, there are no points of reaction due to suture constriction, and epithelium covers the entire field.

The present paper is not an essay on wound closure, though such an essay might well be written, for many, I am aware, regard this step as so unimportant a detail of an operation that its performance is beneath the dignity of the operating

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<sup>1</sup> Keen's System of Surgery, 1908, vol. iii, Fig. 152, p. 272.

surgeon himself. It is, however, a deserving detail of these measures, not only when a subsequent reopening is premeditated, but for the reason that in the case of a fresh first-stage wound, especially when clamps have been necessitated owing to venous stasis, some further loss of blood will occur during the closure. For it is inadvisable to attempt to ligate the bleeding points in the tough scalp, as the external approximating sutures may be relied upon to effectually control them; and to place and tie these sutures accurately and rapidly requires a full and not a crippled operative team.

Impatience to attain results is characteristic of the species surgeon and often leads to the taking of unjustifiable risks—one of the reasons for the high mortality ascribed to major intracranial procedures, those for tumor in particular. The writer is no exception and constantly finds it necessary to curb himself in the desire to do just a little more. But far more tumor operations have been carried to a successful outcome by the courage to temporarily withdraw after a bad start than by banging at hazards. Annoying though it is, it may improve one's score when in difficulties to play back with the loss of a stroke.

Postponement may thus be justifiable merely in view of a badly taken anæsthetic—and no tumor patient in whom pressure is considerable takes the anæsthetic any too well, even with the most skilful administration. At a subsequent trial circumstances may be more fortunate, or a preliminary dose of scopolamin with morphia or atropin, or a combination of chloroform and ether, may serve to offset the earlier difficulties. For cyanosis increases intracranial pressure by accelerating cerebrospinal fluid secretion,<sup>2</sup> which adds to the venous obstruction and so to the loss of blood—a bad cycle all around.

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<sup>2</sup> This is particularly true of ether, which, though the safest drug to employ, is unquestionably the most difficult to administer; and needless to say, its use should be in expert hands. There is less bleeding with chloroform, owing to the fact that it lowers arterial tension; but this in a way is comparable in its consequences to an actual loss of blood and so must be regarded as hazardous, as has been emphasized heretofore. And there are other hazards in the use of chloroform which formerly we did



But rare though it may be to have to abandon progress toward the final stage owing merely to a badly taken anæsthetic, postponement is not infrequently advisable because of excessive loss of blood from scalp and bone, and such a postponement would hardly seem an advance at all were it not for the fact that a blunt reopening of the uniting superficial wound after a few days is attended with relatively little bleeding.

*The Skull.*—All grades of vascularity may be encountered, and chief reliance must be placed upon the proper use of proper wax, for the introduction of which Horsley deserves the lasting gratitude of us all. The cases which present the greatest difficulties are those in which a superficial tumor of long standing receives or discharges much of its blood supply through the diploetic spaces of the bone. This is particularly true of the large dural endotheliomata, which are often associated with extreme vascularity of the adjacent skull, even though the immediately overlying bone may be thinned by pressure atrophy. The enlarged diploetic channels, in these cases, sometimes the size of a radial artery, are often traceable on the radiographic plates, which in this way may be useful even though they rarely show actual shadows of the tumor. At times the very surface of the exposed skull may be so roughened and vascular that it must be rubbed with wax to check the extensive oozing from countless points.

But even with the generous use of wax, considerable loss of blood may be unavoidable in the process of outlining the bone flap under these conditions of abnormal vascularity with extreme venous stasis. For though extravasation from the bone edges may be controlled, it is less easy to combat the free bleeding due to the separation of meningeal emissaries, particularly if the incision be carried into an area of new-formed arachnoidal villi with a distribution beyond the usual

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not recognize, namely, the hepatic necroses which in greater or less degree are a constant feature of chloroform administration and are particularly extensive after a readministration, when, as Dr. George A. Whipple has found, there is an especial tendency even to spontaneous bleeding, owing to the loss or diminution of one of the elements necessary to clot formation.

confines of Pacchionian granulations. In any case it is well to give the longitudinal sinus and its lateral lacunæ a wide berth, and not to outline the mesial edge of the proposed flap nearer than two or three centimetres from the midline. Should an exposure of the foot area be deemed necessary the safest method of approach is to turn down a low flap and subsequently cut out a bay from the upper edge, leaving a permanent defect over this dangerous vascular area.

Whether one prefers to outline the bone flap with electromotor or hand-driven instruments,—and I regard the latter as much the safer,—bleeding is likely to occur from the lacerated osteodural communications at the upper margin. For this reason it is our custom, after making the primary large trephine opening and the secondary opening with perforator and burr, to immediately pass a dural separator between the two, so as to break up the vascular attachments at this early stage. For when the instrument is withdrawn, the cerebral tension is sufficient to again plaster dura against bone and effectually check the bleeding, so that by the time the lateral margins of the flap have been cut, many of the emissary vessels will have become spontaneously occluded.

Postponement at this stage owing to loss of blood may sometimes be desirable, even before the flap, though thoroughly outlined, has been lifted away from the adherent dura. The advisability of this can often be gauged by the anæsthetist better than by the operator, and by a blood-pressure tracing better than by a finger on the pulse. The procedure up to this point has been a brief one, there will be a quick recovery from the anæsthetic, and a certain amount of pressure relief will be experienced through the slight elevation of the still adherent flap.

It is of course far more often possible to elevate the bone flap; for conditions such as may have rendered postponement advisable at a stage earlier than this are naturally rare. One must realize, however, that it takes nearly as long to get out of as it does to get into the intracranial chamber, and as there is likely to be about as much bleeding during the process of with-

drawal as during entry, such blood as may be lost during further advance must be multiplied by two. And one should not wait for a profound upsetting of the pressor mechanism, for it does not go to pieces gradually, but suddenly. This is well exemplified in transfusions, for a large amount of blood may be given up by the donor with no appreciable change in his condition, until a little pallor, increased respiration, and restlessness indicate the need of uncoupling. Checking the flow at this stage is followed by complete readjustment within a few moments, and one is often thus misled into the thought that more blood might safely have been withdrawn; but this extra straw will often so upset the regulatory mechanism that hours or days are needed for a complete restoration.

*The Dura.*—We have come to a stage of the osteoplastic operation which calls for especial tricks of hæmostasis, and the following adjuncts have been found useful: (1) *Small pledgets or "tips" of gauze* of various sizes secured by a black ligature, so that though blood-stained they can be easily located—minute Mikulicz pads as it were. (2) *Sterile absorbent cotton* to be used *dry* and plastered on an oozing surface, or *wet* in hot saline solution, a bowl of which at a temperature of 100° to 105° F. should be on the instrument tray immediately at hand. This dripping cotton is the best material for washing meningeal surfaces, and, when wrung out into flat pads, is the safest and most effectual substance for sponging or for temporary placement in deep cerebral wounds. (3) *Bits of living tissue*—supplied, for example, from the exposed temporal muscle—which serve admirably as a means of checking venous extravasation from points on the dura, and *fragments of partially organized blood-clots*, obtainable at a second-stage performance, are similarly useful. Finally (4) *silver wire "clips"* for placement on inaccessible vessels, which, though within reach of a clamp, are either too delicate or in a position too awkward for safe ligation.

On first elevating the flap there may be, particularly in cases with stasis, quite an abundant loss of blood from the raw surface of the dura. This bleeding comes from two sources,

arterial and venous; that from the latter being by far the more troublesome; for only in case of a torn meningeal at the lower anterior angle, due to its having deeply channelled the bone where this has been broken in turning back the flap, will arterial bleeding give trouble. When this occurs it is naturally the first thing to need attention, and if there is venous bleeding from the raw dural surface, it can meanwhile be temporarily controlled by promptly covering the whole surface with a large pad of the hot and dripping cotton, which is immediately dried out against the oozing dural surface by pressure with a gauze sponge. The arterial bleeding should then be checked without attempting to catch or ligate the vessel, which may be torn back "hang-nail" fashion. Some of the prepared gauze pledgets of proper size can be tucked under the bone, separating the dura from it until a point is reached where the vessel no longer channels the bone. Then the pressure of the pledgets against the tense dural surface will control the bleeding until later in the operation, when with an open dura the vessel can be caught by a "clip" if it proves to be inaccessible to a ligature.<sup>3</sup>

Permanent control of the venous bleeding is a more difficult matter. The artery, as its branches approach the upper part of the exposed area, is accompanied by many dural veins which have a more or less intimate connection with the bone, and many raw, bleeding points may be left after their separation. These points, especially if associated with Pacchionian granulations, may give a great deal of trouble during the further procedure, and indeed may continue to ooze after replacement of the flap and closure of the wound; and thus in the course

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<sup>3</sup>Loose gauze pledgets of minute size, possibly a centimetre in circumference, are particularly valuable in ganglion operations. For one of them can be plastered against a bleeding point, say at the foramen ovale, and its anchoring ligature led out of the wound, leaving a sufficient exposure of the remaining field to allow for further progress in separating the dural envelopes. By using the proper tricks to control hemorrhage, in none of our last seventy-five cases has it been necessary to postpone a ganglion operation until a second session, and in none has it been necessary to place a drain.

of a few hours a thick extradural clot may form and give pressure symptoms. In our earlier experiences this was an occasional postoperative complication, and even now the possibility of its occurrence is always considered. The fact that dura and bone have been separated makes the formation of such an extradural clot possible, as the result of slow venous oozing, whereas in the ordinary extradural hemorrhage of traumatic origin, the extravasation comes necessarily from a ruptured artery. In other words, the tension of a purely venous extravasation under the latter circumstances would not suffice to peel the adherent membrane from the bone.

Even when the venous oozing seems at the close of the operation to have been effectually checked, postoperative vomiting or straining may start the bleeding anew by dislodgement of terminal thrombi, and for this reason in all cases in which the performance has been a bloody one the patient should not be lifted from the operating table until he has recovered in large measure from the anæsthetic. The table therefore should be made sufficiently comfortable by having a thick mattress covering, for it may be inadvisable to move the patient for two or three hours, and, indeed, it is not exceptional for critical cases to be kept in the adjoining recovery room over night before they are transferred to the ward. With such precautions, in addition to skilful administration of the anæsthesia, postoperative retching and vomiting are rare.

Oftentimes the gauze "tips" or pledgets of cotton, which, during the progress of the operation, have been used to cover and which have become adherent to bleeding points in the dura, cannot be removed without starting the bleeding afresh, so that one is occasionally tempted to leave the foreign material plastered against the dura in the hope of its becoming safely organized. This, of course, is undesirable (though we have found in animal experimentation that the cotton pledgets as a rule are well cared for) and also unnecessary, for an alternative has been discovered in *bits of living tissue* or *well-solidified blood-clots*. Small snips of tissue may be cut from an exposed raw surface, such as the temporal muscle—and muscle seems

to be particularly valuable as a hæmostatic—and when held for a moment on the bleeding point by a smooth instrument they will adhere more promptly and check further extravasation far better than gauze or cotton. Since this device for checking bleeding was first hit upon some two years ago, we have made frequent use of it, with most satisfactory results.<sup>4</sup>

It is possible that any living tissue will suffice. In a recent case of extirpation of a cerebellopontine tumor a troublesome point of venous bleeding was left at the side of the pons. It was controlled by a small piece of dura which, as the most available tissue, was cut off and plastered against the side of the brain-stem, adhering and effectually checking the bleeding after a few moments of gentle pressure. Organizing clots may also be utilized. They are particularly available in second-stage procedures; and at present, instead of scraping away the clots from primary trephine openings and discarding them, they are carefully preserved in saline gauze, and sections of them utilized in the same way as the bits of muscle tissue. Doubtless it will be found that tissue fragments can be prepared beforehand and kept sterile for this purpose.<sup>5</sup>

It is at this period—with a reflected bone flap and all bleeding from the dura checked—that postponement is most often advisable, not only on account of the loss of blood up to

<sup>4</sup> Since this paper was put together I have learned from Dr. Lund's interesting report of the visit last summer of the Society of Clinical Surgery to Great Britain that Sir Victor Horsley demonstrated "the hæmostatic action of a fragment of muscle" on the exposed brain during the progress of a laboratory experiment. It is not unlikely, therefore, and is indeed probable, that one or all of the "tricks" which I have here set down have been in use by others who have not regarded them of sufficient importance to record.

<sup>5</sup> If Bernheim's conclusions (*Jour. Am. Med. Assoc.*, 1910), that the walls of the blood-vessels possess more active clotting elements than do other tissues, prove to be correct the walls of preserved vessels may be applicable for this purpose; or the fibrin from whipped blood might be so prepared that it could be immediately plastered on bleeding surfaces, just as cotton is now used, and thus obviate the necessity for any subsequent replacement. Or, as Carrel has suggested (*Jour. Exper. Med.*, 1910, xii, 460) for the preservation of blood-vessels, we may be able to preserve tissues *in vitro* for these purposes in a condition of "latent life."

this stage, but more particularly should the membrane be so tense that cerebral protrusion of a dangerous degree is likely to occur through an immediate dural opening. Under these circumstances, even in the bone-flap operation, the principles of decompression come into play; for it cannot be emphasized too strongly that a rapidly forming hernia, comprising functionally important areas of a tense cortex which protrude through an immediately superimposed dural defect, often leaves irrecoverable paralyses. Hence, unless a tumor is obviously subjacent and there is every prospect of its removal at the first sitting, recourse should be had to a temporary palliative measure with a dural defect over a silent and preferably over the subtemporal area.<sup>6</sup>

In the making of a palliative subtemporal defect, whether a primary operation or one to be combined with a temporary osteoplastic resection, it is important that the fibres of the overlying muscle be preserved as intact as possible. This necessitates, particularly in the case of a primary decompression, the careful rongeur-ing away of the thin bone of the temporal region far under the edge of the split muscle, with an exposure of an area of dura carrying the main branches of the middle meningeal artery. Hence, when the dura is incised radially from a primary central opening to the margins of the bone defect, some of these branches, particularly the posterior radicle of the artery, are likely to be divided, and unless precautions are observed, bleeding may be troublesome. If the spoon-shaped spatula<sup>7</sup> is used to hold the tense brain away from the dura while the radial cuts are being made, the arterial branches can usually be seen before they are divided, and a delicate clamp of the Halsted pattern can be applied on each side of the incised membrane even in the deeply overlain parts of the wound inaccessible for ligation. But what to do with these deep bleeding points after they were thus caught often

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<sup>6</sup> A useful method of combining at this stage a decompression with the exploration has been elsewhere described (*Surg., Gynec. and Obst.*, vol. iv, 1909, pp. 1-5). It has been put into practice in some thirty or forty cases with uniform satisfaction in the results.

<sup>7</sup> *Surg., Gynec. and Obst.*, 1909, vol. iv, p. 3, Fig. 2.

gave us great concern in our earlier operations; and on one or two occasions it was necessary to divide the muscle transversely in order to obtain sufficient exposure for ligation. These difficulties have been overcome by means of silver "clips"—a device which possibly deserves the especial description given to it later in this paper.

*The Brain.*—The central nervous system can be seriously damaged in the attempt to employ the usual methods of hæmostasis with gauze, clamp, and ligature commonly used for other tissues. From its first exposure, every effort should be made to avoid any injury to the pia-arachnoid until the actual moment of entry to the subcortex for the purpose of exploration or enucleation of an obvious growth, and such entry and proposed enucleation must be carefully planned out in accordance with the disposition of the cortical vessels. A safe enucleation may be completely frustrated by gauze sponging or otherwise roughly handling a brain under tension, by the protrusion and rupture of the tense cortex through the primary dural opening, by the accidental injury of a cortical vein carelessly wounded during the enlargement of the dural incision. The struggle to control the consequences of these seemingly trifling matters, which leave in the end a large patch of broken and infiltrated cortex through which ligatures have cut and against which gauze sponges have been held, is only too familiar, and operations for tumor are usually terminated by such an occurrence.

Familiarity with the tricks of lessening tension is all-important in the prevention of these accidents, and the different methods of dealing with a "dry" or "wet" brain by primary decompression, by pricking arachnoid spaces, by ventricular or lumbar punctures, by changes of posture and what not, is a subject too large to be dealt with in the present paper, though indirectly bearing a close relation to loss of blood incidental to manipulations of the nervous tissues themselves. The whole matter hinges more on the disturbances of cerebrospinal circulation than upon the size and position of the tumor. For with a smoothly taken anæsthetic there may be little or no



difficulty in manipulating a brain holding the largest of growths, whereas cyanosis with increase of stasis may make the exposure of a brain, under previously normal conditions of tension, hazardous in the extreme. A small growth of the brain stem, on the other hand, may lead to a great stasis of fluid, the embarrassments from which can be promptly set aside by a ventricular puncture. In any event, a satisfactory subdural exploration can only be made after a considerable diminution in tension has been brought about in one way or another.

The question of tension, furthermore, is quite apart from the actual primary vascularity of the growth, for some of the most vascular lesions, which consequently are difficult to handle, fortunately may be uncomplicated by tension, just as tense brains may hold relatively non-vascular growths which are readily enucleable. However this may be, great care should be exercised in attacking a growth when once it has been brought into view and has been given the wide exposure essential to a safe attempt at extirpation.

Notwithstanding the statement of physiologists to the contrary, one rarely if ever sees "shock" in cerebral operations as a thing apart from hemorrhage or injury to some vital centre. This is abundantly supported by certain of our experiences with extensive cerebral manipulations at second-stage operations in unanaesthetized patients. Hence, with careful choice of the stage at which an extirpation may be attempted—meaning largely an unbled subject—an abundance of time and patience should be expended in the careful and slow manipulations necessary for the dislodgement of the tumor. The tearing out of a growth by the insertion of the fingers means a fragmental removal, extravasation and œdema from unnecessary damage, and blind points of hemorrhage most difficult to identify. On the other hand, it is astonishing how dry the subcortex may actually be if care has been taken in respect to the superficial vessels. One can usually find a safe point of entry through the cortex; and much of the remainder of the operation consists in the slow separation of brain from tumor,

working now here, now there, leaving small, flattened pads of hot, wrung-out cotton to control oozing for the time being from a given area, until it can be again attacked. I know of no better training in such procedures than can be gained by the experience of making clean-cut extirpations on the lower animals—let us say of the motor territory of the canine brain.

A few fine silk (bead) ligatures may be passed on delicate curved needles to secure some of the vessels crossing the line of proposed cortical (circumferential) incision if one is necessary, but care should be taken not to include the large *Venæ anastomoticæ* or important branches of the middle cerebral artery, lest outlying areas of softening result and leave unexpected and unexplainable palsies to be answered for. Indeed, it is often surprising how widely one can push aside many of these vessels in the pia-arachnoid which at first would seem unquestionably to need ligation.

The actual tilting out of a tumor is largely a one-man performance, and the operator's left hand is necessarily occupied in holding and guarding the tissue in process of separation. The manipulations meanwhile are carried on by slow, blunt dissection with the right hand, while an assistant keeps the field clean by the careful use of wet cotton pledgets. During the progress of the measure, particularly in the case of a deeply seated tumor, vessels may be encountered passing from brain to tumor and lying in tissues in which it is obviously futile to place an ordinary hæmostatic forceps. Under these circumstances the silver "clips" to be described may be found to be useful, just as they are in the presence of dural bleeding from points awkward of access; for the jaws of the instrument holding the clip will pick up the visible vessel or bleeding point just as would the ordinary clamp, the "clip" being left to take the place of an actual pendent instrument.

Despite the rapidity with which the surrounding brain tends to fill up the gaping hole left by the final dislodgement of the growth, the raw surface of the cavity may continue to ooze. This condition can best be controlled by filling the hole with a wad of dry absorbent cotton which is replaced as it becomes

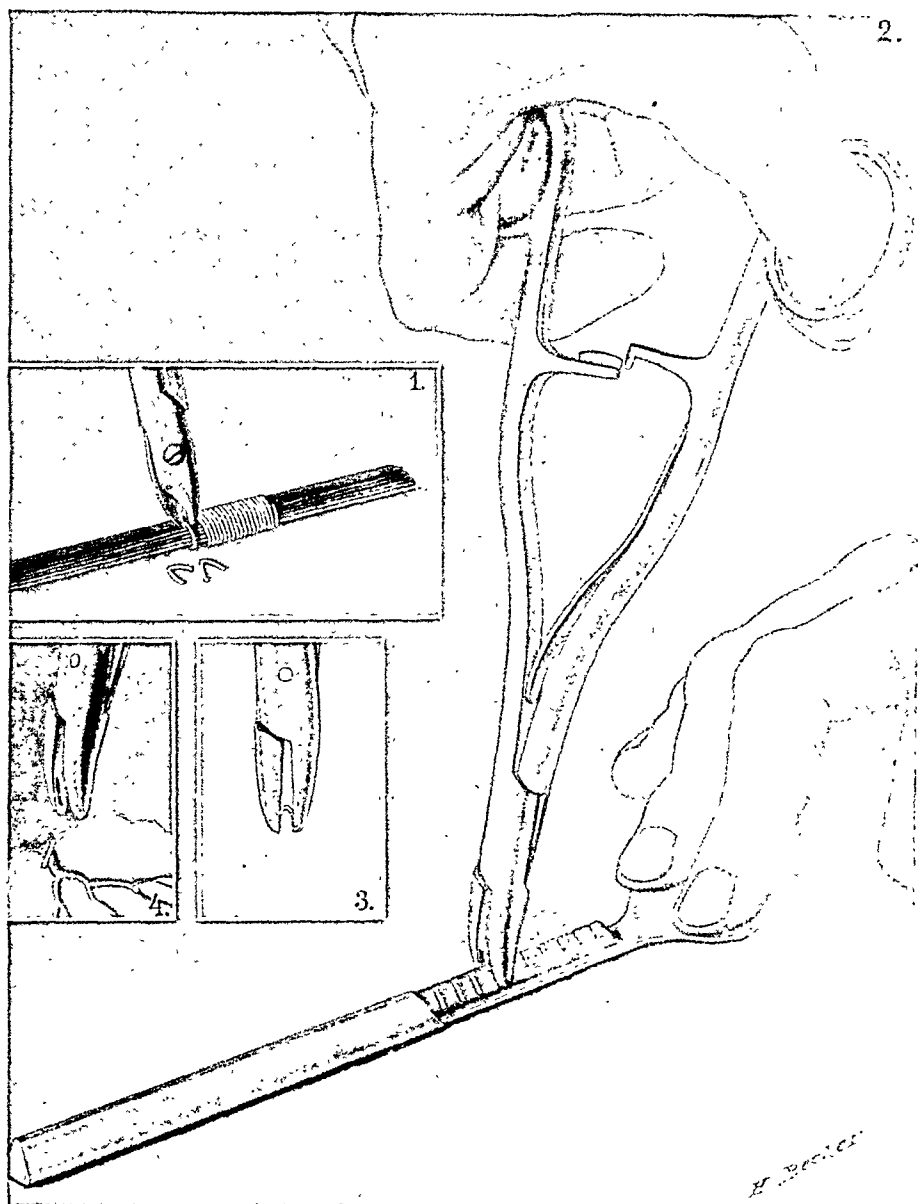
saturated. Ultimately the contracting cavity will be left sufficiently dry to justify closure without drainage, for a drain leading from the nervous tissues to the external world should never be used if it can possibly be avoided. The cavity, even if large, should be filled with normal salt solution, and the dura closed as accurately as possible over it. Even if it has been necessary to leave a defect in the dura overlying the cavity, the same principles are to be adhered to.

It was formerly our custom, in order to draw off the excess of bloody fluid as the brain tended to swell and fill the cavity, to leave one or two folded protective wicks, which were led from the cranial chamber through the primary trephine opening to a puncture in the scalp, outlying the original line of incision. For in this way an oblique passage is insured, and one which is easily occluded by pressure after the withdrawal of the wicks. But particularly in second-stage performances we have found this to be less and less necessary as we have learned how to leave a dryer wound. In the case, for example, of the tumor pictured in Fig. C., the huge cavity left by the removal of the growth was merely filled with salt solution, the flap replaced, and the wound closed with no drainage whatsoever.

#### SILVER-WIRE CLIPS AS LIGATURES

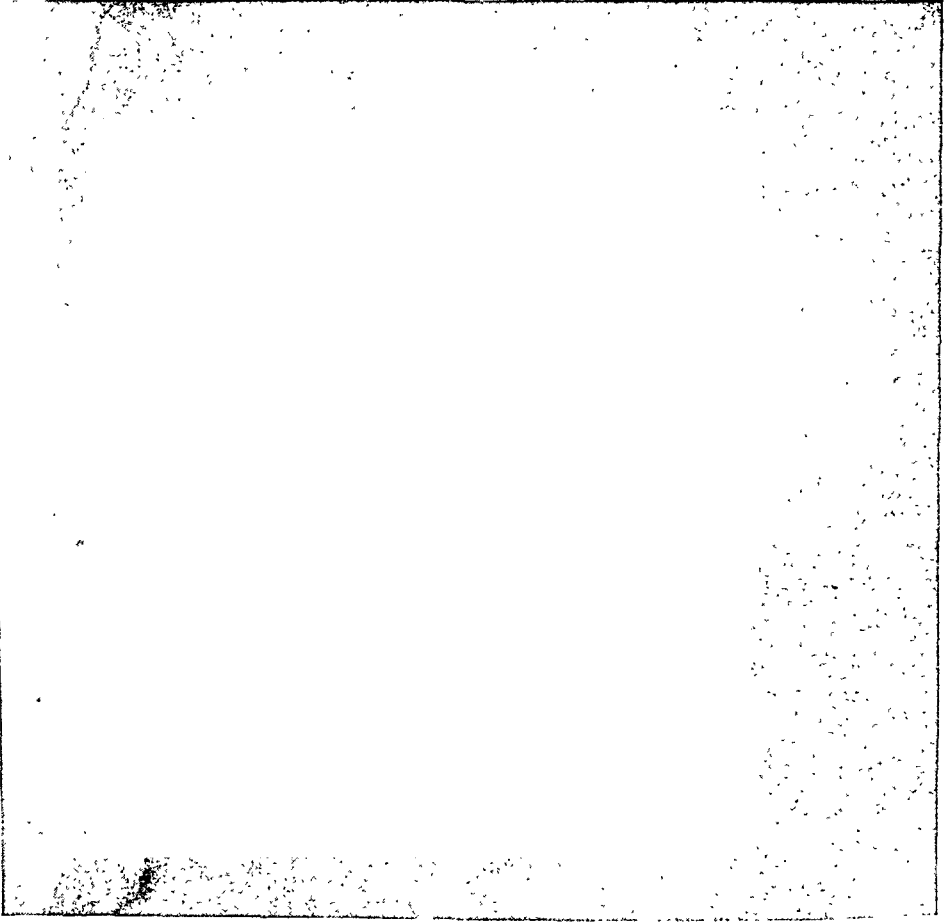
The thought has doubtless occurred to many that much time and trouble would be saved in major operations could there be devised some form of hæmostatic clamp, the mere placement of which would leave a fine, knotted ligature on the bleeding point so as to obviate the alternatives which we now possess, either of leaving a pendent instrument or taking the time necessary for ligation. Some one will probably have the ingenuity to construct an instrument of this kind, which will be useful not only for such extensive performances as complete breast amputations, where many delicate vessels must be secured along the axillary vein and where the temptation is great, to leave dangling a heavy mass of clamps, but also in operations during which vessels are necessarily divided at

FIG. A.



Drawing to show (1) silver wire loops being cut after wrapping on grooved steel pencil; (2) one of the clips being picked up from the loaded magazine; (3) clip in position in jaws of holder; (4) clip placed on meningeal vessel at the edge of a dural incision, the empty instrument showing the mould for the clip. (Reduced one-third.)

FIG. B.



X-ray of a patient's head after subtemporal decompression, during which four clips were placed on bleeding points in the dural margin. Showing unobstructed view of normal sella turcica, two of the clips being in line with its posterior border.

FIG. C.



Dural endothelioma (actual size) with adherent clips. Tumor successfully extirpated at second stage, weighing 200 grammes. Bone-flap operation; closure without drainage; uncomplicated recovery.

FIG. D.



Clips adhering to the inferior thyroid stump of an enucleated intra-thoracic goitre (slightly reduced).

depths easily reached by a clamp but in positions awkward for ligation. It was doubtless this thought, coupled with a knowledge of the ingenious instrument used by some surgeons for closing skin wounds by the superficial placement of removable, toothed metal bands, that led to the device which we have come to employ.

Some three years ago a small U-shaped bit of wire held in the jaws of an ordinary clamp was first successfully used to check bleeding from a troublesome meningeal vessel divided in a subtemporal operation. As further trials were made on subsequent occasions, the difficulties of holding the small bit of wire in position were overcome by an indentation (Fig. A, 4) in the blades of the clamp in which the wire could securely lie. The wire U's have finally come to be made in large numbers and of equal size by cutting them from a flat metal pencil; around which the wire has been previously wrapped (Fig. A, 1). In order to furnish clips which will not slip easily from the tissues on which they are placed, the metal pencil is longitudinally grooved, so that by lightly tapping the wire, after winding, the inner surface of the loops become transversely ridged. A deep median groove allows the pointed wire-cutters to snip the several loops (Fig. A, 1) of the same size. They are then loaded on a magazine and picked up individually, as needed, by the holder (Fig. A, 2). The first "catch" of the holder locks its sprung handles at a point which closes the jaws sufficiently to enable them to take up the loop from the magazine without deforming the easily compressed wire, and the instrument unlocks itself when the U has been flattened against the bleeding point (Fig. A, 4). These matters are made sufficiently clear by Mr. Becker's excellent drawing without further description.

The instrument in its present form has been put to use at some stage or another in almost all of our operations on the brain for the past year or two. Like any tool, however, a certain amount of experience is necessary before it can be used with facility. In the hands of some ingenious mechanic it would doubtless be capable of much greater perfection; it



would be well to have a self-loading tool if one could be constructed without its being too cumbersome.

The "clips" have been found useful for the occlusion of inaccessible vessels divided in the dural incisions of decompressive operations (Fig. B), for the occlusion of the meningeal at the foramen spinosum if its division is advisable during the operation for trigeminal root avulsion, and, as has been stated, during the enucleation of cerebral tumors for the occlusion of the vessels passing from cortex to tumor—vessels the position and delicacy of which often make ligation well-nigh impossible (Fig. C).

Though from the present character of my operative work I have had little opportunity to test the value of these silver "clips" in operations other than those on the brain, I can recall occasions in intra-abdominal work when the instrument would have been most useful—occasions when a bleeding vessel, such as the artery of the cystic duct, in the depth of the wound could be caught by a clamp but in a position difficult for ligation, particularly if the operator's left hand was occupied in holding the viscera aside to secure the necessary exposure. The "clips," however, have been utilized in a recent enucleation of a large intrathoracic thyroid tumor (*goitre plongeant*) in a case of acromegaly. The tumor, the descent of which had doubtless been encouraged by the skeletal enlargement of the upper thorax, had exerted pressure against the superior vena cava, and venous stasis of the entire upper body was so extreme as to give an appearance of a malignant mediastinal growth. During the process of dislocating and delivering the growth from its subclavicular position, many of the inferior thyroid vessels below the clavicular level were clipped before their division in positions which would have made ligatures very difficult to apply and the placement of a number of clamps out of the question (Fig. D). "Clips" similarly have been successfully used by Emil Goetsch in such delicate procedures as the experimental occlusion of the canine hypophyseal stalk, and by L. J. Crowe for securing the bleeding points after a tonsillectomy. It is not improbable that similar instruments

fashioned to carry loops of stouter wire and of larger calibre might prove useful in occluding vessels larger than those for which we have heretofore used the device.

*Summary.*—One of the chief objects of concern in intracranial surgery should be the avoidance of any unnecessary loss of blood, for at best, in many cases of brain tumor associated with venous stasis, bleeding is likely to be so excessive as to necessitate postponement of the final steps of the procedure until a second or even a third session.

The common methods of blood stilling by sponge, clamp, and ligature are largely inapplicable to intracranial surgery, particularly in the presence of bleeding from the nervous tissues themselves, and any device which serves as an aid to hæmostasis in these difficult operations will bring a larger number of them to a safe termination at a single sitting, with less loss of blood and less damage to the brain itself.

In addition to the more familiar tourniquet for the scalp, and wax for diploetic and emissary bleeding, suggestions are offered as to the use of gauze pledgets, dry sterile cotton, fragments of raw muscle and other tissues, as well as sections of organizing blood-clots for superficial meningeal bleeding, and silver "clips" for inaccessible individual points either in dura or brain.

The successful consummation of any critical operation often depends upon seeming trifles. It is, however, the scrupulous observance of surgical minutiae that makes possible the safe conduct of major intracranial performances—performances which a few years ago were attended in most cases by a veritable dance Macaber.

# SUBLUXATION OF THE ATLAS.

REPORT OF TWO CASES.

By LEONARD W. ELY, M.D.,

OF DENVER, COLO.

IN ANNALS OF SURGERY, vol. li, No. 2, appeared two articles dealing with subluxation of the atlas on the axis, one by Mixter and Osgood, and the other by Pilcher. One showed the good results of a necessary operation, and the other the favorable outcome of a case following a fruitless surgical interference, that is, under practically no treatment except that by a retentive apparatus for a time after the operation.

The two cases I would report include one similar to Mixter and Osgood's, and one similar to Pilcher's.

In the article by Mixter and Osgood appears a review of the bibliography<sup>1</sup> of the subject, as well as the study of the mechanics of the lesion.

The history of the operative treatment of spinal fractures and dislocations is a disheartening one. Some of the most enthusiastic advocates of radical measures have little on which to base their recommendations but a list of disastrous failures. If the cord be badly crushed, operation is evidently quite use-

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<sup>1</sup>In addition to the cases cited by Mixter and Osgood the following may be mentioned. The list is probably not complete:

Eisendrath: Rotary dislocation. Death a few minutes after a fall upon the head from a bicycle. Death caused by "slipping backward of odontoid process." Ligaments torn. Specimen at autopsy. ANN. OF SURG., xlii, 245.

Corner: ANN. OF SURG., xlv, 9, Rotary Dislocations of the Atlas. Gives 20 cases, including two of his own. Some died immediately, some later, some were reduced by extension and manipulation. He thinks the lesion is fairly frequent.

Wilson: ANN. OF SURG., xlv, 632.

Bogardus: International Journal of Surgery, vol. xxiv, No. 2.

A very interesting description of this lesion may be found in Deutsche Chirurgie, 1878, Lief 40, S. 284. Die Verletzungen der Wirbelsäule und des Rückenmarks, von W. Wagner and P. Stolper.

less, but apparently it is not always possible to tell before operation whether the cord is crushed or only suffers from pressure. If the latter, then operation planned without a definite and logical idea will not suffice to cure. The procedure of 'Osgood's is brilliant in the extreme, very ingenious, and shows what can be accomplished by a well-timed and correctly planned surgical interference. A reference to standard text-books and to medical articles will show that the prognosis heretofore has been practically hopeless.<sup>2</sup>

CASE I.—W. W., age thirteen, occupation, schoolboy. Seen May 11, 1909, Roosevelt Hospital, Out-Patient Department.

The patient says he was sick with rheumatism in his right ankle, knee, and shoulder last autumn, for a period of two

<sup>2</sup> Scudder: *The Treatment of Fractures*, Philadelphia and London, W. B. Saunders Co., 1907, p. 94. "Injuries to the first two cervical vertebræ. If the displacement is slight, life may be spared until sudden displacement occurs or a secondary myelitis causes death. Cases of recovery are recorded. Death usually occurs immediately. Perhaps one person in fifty thus injured recovers (Gowers)."

Hopkins: *A Clinical Treatise on Fractures*, Philadelphia, J. B. Lippincott Co., 1900, p. 187. "Fractures of the atlas and axis are usually immediately fatal through the almost inevitable injury to the medulla accompanying them."

Cotton: *Dislocation and Joint Fractures*. "Dislocation of the atlas on the axis—such dislocation is possible only when the odontoid process is slipped out from under the transverse ligament, when it tears through this ligament, or when the odontoid itself is broken and displaced—the last being most common."

"In almost all these cases the luxation of the atlas is forward—in some cases forward and to one side."

"So few of these cases of injury to the first two cervical vertebræ survive the trauma that data for diagnosis are scanty."

"Open operation—laminectomy—seems to show no encouraging results in this class of high lesions."

Helferich: *Fractures and Luxation*. "Both of these are generally fatal," i.e., luxations between occiput and atlas, and between atlas and axis.

Roswell Park: *Surgery by American Authors*. "The symptoms of injury to first, second, and third cervical vertebræ are death."

Da Costa: *Modern Surgery*. "Fracture dislocation of the atlas or axis usually causes instant death. When the displacement is only trivial, the patient may actually recover, but will probably die of secondary cord disease."

months. He recovered completely, and about one month later his neck grew stiff, and has been stiff since. He suffers some pain.

Examination shows a boy in good condition. His face is turned to the left, but his head is almost erect. Respiration is rather loud. Marked stiffness and spasm are present in the neck muscles, and the motions of the head are limited in all directions. A sharp prominence of the spine at about the third cervical is plainly evident.

A skiagram reveals a forward dislocation of the atlas and head upon the axis.

*Treatment.*—A grand Calot jacket was applied. While the patient was suspended, an attempt was made to reduce the deformity, but in vain.

Oct. 4, 1909: Plaster jacket removed. Marked restriction of rotation of the face toward the right is present, but other movements are fairly free.

Nov. 22, 1909: The patient feels perfectly well, and plays with his comrades. His face is still turned to the left, and this turning motion to the left is the only free one in the neck. The boy now admits that he fell on the ice nine months ago while skating, and that the symptoms supervened immediately.

April 25: No change as to local condition.

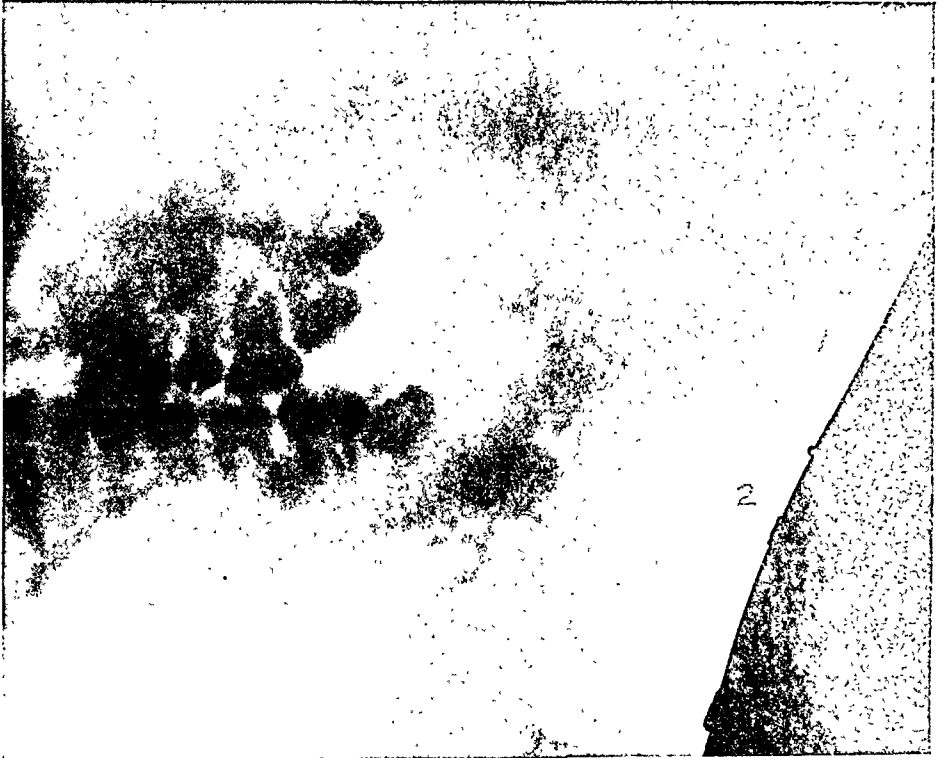
The second case is so instructive that it may well be detailed at length:

CASE II.—B. B., male, sixteen years old, glassworker, patient of Dr. V. H. Norrie. Seen in consultation at Bellevue Hospital. Admitted Sept. 2, 1909.

Nine weeks ago the patient fell down an elevator shaft, nine feet, striking on the left side of his head. He was unconscious for two or three minutes, then walked with assistance to a drug store. He bled from a scalp wound, but not from the ears, mouth, or nose. His wounds were dressed and he went home, free from paralysis and stiffness, but with a pain in the upper thoracic spine and in the left side of his head. The spinal pain disappeared the next day, but the headache persisted for four weeks.

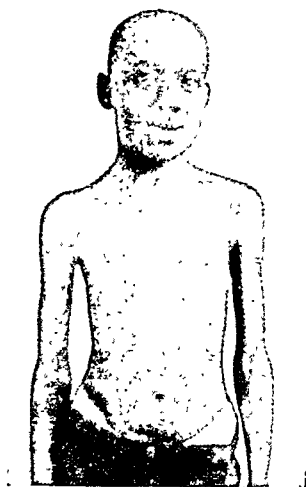
Three days after the injury the patient's neck began to grow stiff and to pain unless the head was held carefully to the right.

FIG. 1.



Skiagram of Case I.

FIG. 2.



Note characteristic attitude  
of head. (Case I.)

side. Five weeks ago Dr. Carl Beck took an X-ray plate and put the neck up in plaster, with the head straight, for two weeks. On taking off the plaster, the head again deviated to the right and the stiffness persisted. The patient removed the plaster without permission, because he was tired of it.

Eight days ago, the patient felt cold and had a feeling of numbness and tingling, followed by marked sweating. He was put to bed and became gradually paralyzed, first in the left arm, then partially in the left leg. He has had no sensory symptoms but has had partial incontinence of both urine and fæces.

Chief complaint, pain and stiffness in neck, and paralysis.

The following notes of the physical examination are copied from the hospital history:

*General Appearance.*—The patient, a boy about fifteen years of age, well nourished, good color, of good musculature, lying in bed and complaining of pain in the back of his neck, and of paralysis.

*Paralysis:* Complete of left arm, forearm, and hand. The patient is unable to move the arm off bed or to grasp anything with his hand. His grip is lost. The right arm is incompletely paralyzed. The patient can raise his forearm off the bed and he has slight use of his fingers and of his hand. The grip is almost entirely lost. Left leg: impairment of power is present, more marked in leg and foot than in thigh. The patient drags his foot and leg after him when he walks, and his left foot is never raised more than an inch above the floor.

*Cervical region:* The boy holds his face turned towards the right side. He does this, he states, to ease the pain. There is a distinct swelling in the suboccipital region, and there is a marked rigidity of right and left recti postici obliqui superior and inferior, also of rectus lateralis. There is pain on pressure over this region, and on extreme flexion and extension. The lateral movement is entirely free and normal, and causes no pain. Flexion and extension are limited and painful. There is no bony crepitus, and the cervical vertebræ are in a straight line, with the possible exception of the second and third, which seem to be out of line.

*Sensory disturbances* are not sharply defined. There is an area of absolute anæsthesia about the size of a small saucer in the right upper lumbar region. Below umbilicus, there is a



diminution of sensation to pain on the left side; above, there seems to be no change.

The left side of the face is flatter than the right, but is only slightly changed.

The pupils of the eyes are equal, and react to light and to accommodation. No ptosis, strabismus, nor nystagmus is present.

The tongue does not deviate.

Reflexes: Knee-jerks are greatly exaggerated, more marked on left side than on right. Cremasteric is present on left side, absent on right. Abdominal reflex is equal on both sides. Babinski's sign is present on the right, not on the left side. Kernig's sign is absent on both sides. Ankle clonus is extremely well marked, and seems to be the same on both sides.

Patellar clonus is marked on both sides. Ulnar nerve; some anæsthesia is present on both sides. The diaphragm has normal movement. Mentality is normal. Convulsive movements and fibrillar twitching of entire left leg and, at times, of a single group of muscles, can be seen.

The throat is normal. Speech is unaffected. The teeth are in good condition. The mouth at times is drawn to the left side; this is inconstant.

The chest is of good type; wide expansion, the same on both sides. There are no adventitious signs.

Heart: Upper border in third space, left border,  $3\frac{1}{4}$  inches out, right border at right edge of sternum. Apical impulse in fourth space, 3 inches from midsternal line. No murmurs are present, nor accentuation of first sound at apex.

The pulse is regular, rate 76, good quality, good excursion.

The abdomen is slightly distended. There is no tenderness, no fluid, no masses.

Liver: The lower edge cannot be felt, percusses from fifth space above.

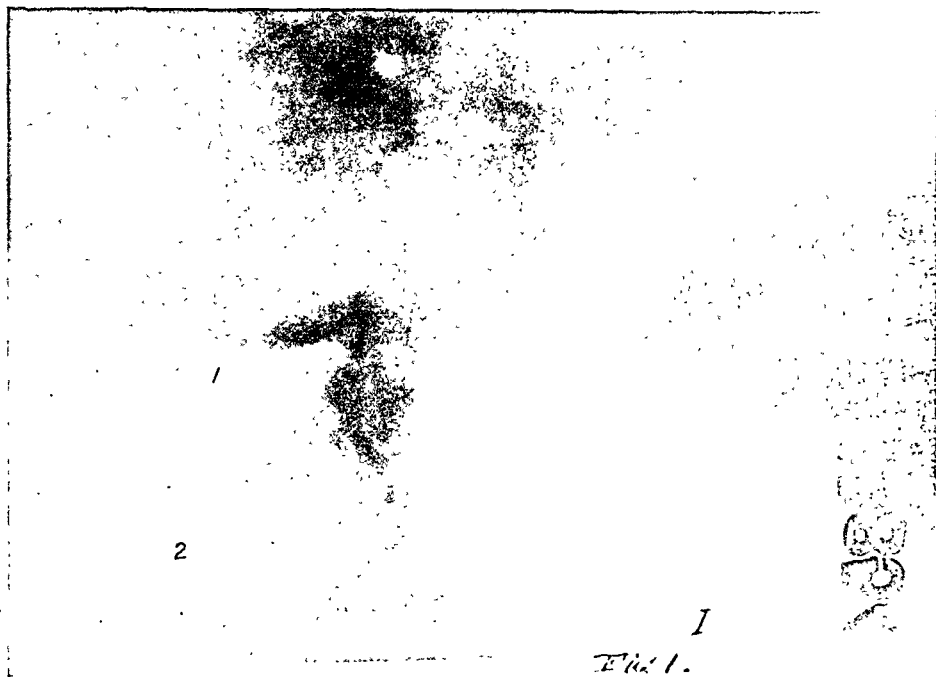
Genitals, results of a normal circumcision.

Lymph-nodes: Axillary, epitrochlear, cervical, and inguinal are of normal size.

A peculiar point about the sensory symptoms was that they changed from day to day.

A skiagram showed a subluxation of the atlas on the axis (see Fig. 3).

FIG. 3.



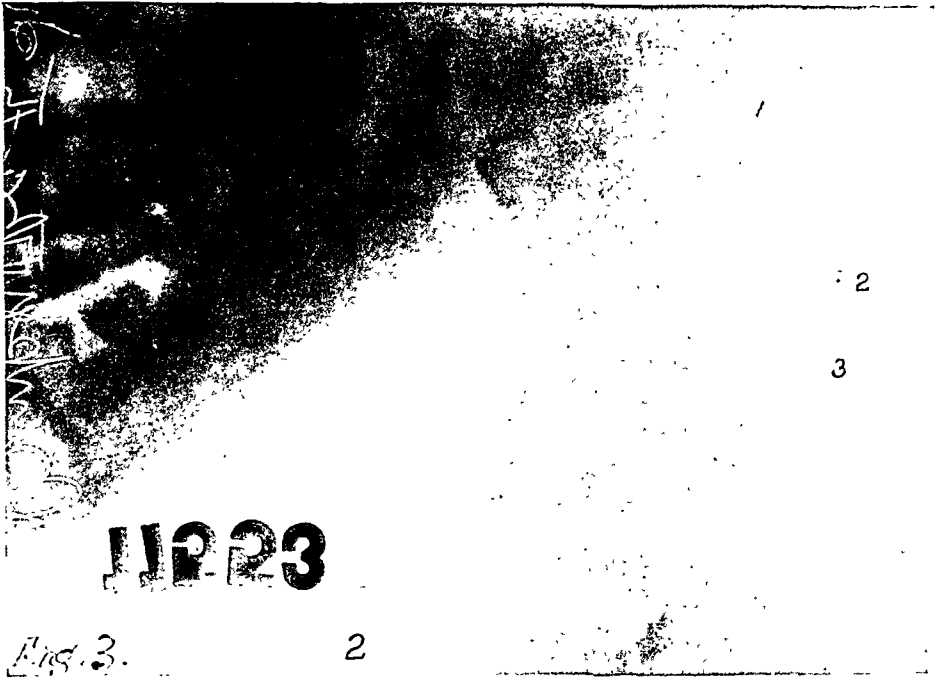
Skiagram of Case II, taken before treatment was begun in Bellevue Hospital.

FIG. 4.



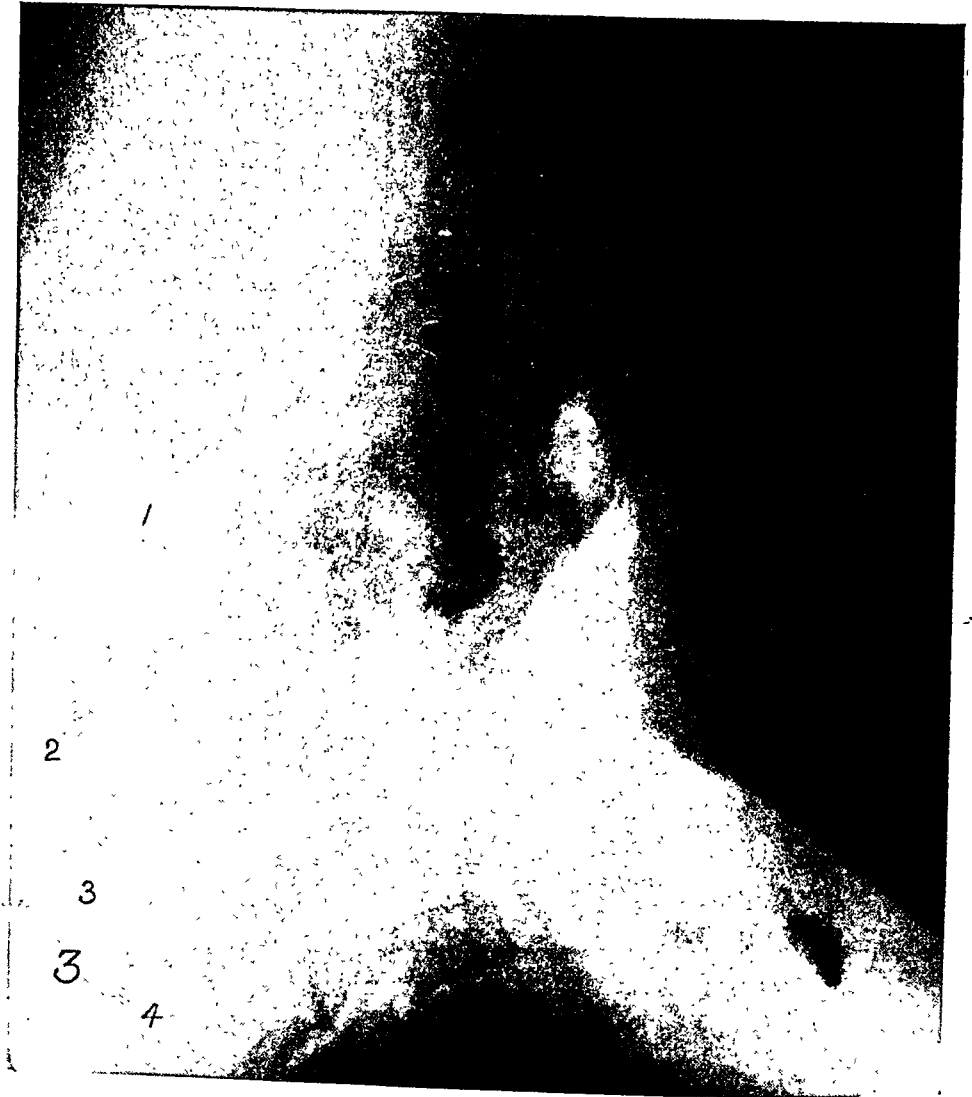
Photograph of patient standing, shortly after the first jacket was applied. (Case II.)

FIG. 5.



Skiagram taken Nov. 20, 1909, after the removal of the first jacket. (Case II.)

FIG. 6.



Skiagram taken January 12, 1911, seven months after the operation. (Case II.)

Sept. 7, 1909: A plaster collar was applied from lower chest to ears by Dr. Ely, covering the chest, neck, and chin up to the ears, and holding the head in extension (Fig. 4). The patient was strung by a Calot head sling, and on account of the paralysis, practically complete in the lower extremities, he simply hung by the neck, limp. He is comfortable, free from pain, and takes food well.

Sept. 10, 1909: General condition is excellent. Power in extremities has much improved. The right leg is practically normal, the left leg is slightly weak, but all movements can be performed. The patient is able to walk.

The right arm is much stronger than three days ago. It can be raised to the patient's head, and the elbow, wrist and fingers can be flexed and extended. The grip is fair. This arm was slowly losing power up to Sept. 7, 1909. The left arm, which was completely paralyzed on admission, has regained considerable power. All movements can be made, but rather feebly and with considerable effort. The grip is rather weak. The hand can be elevated to the nose, but the movement is uncertain. No sensory disturbance can be made out. Sept. 14, 1909: Ankle clonus and increased reflexes still present. Flexors of the left thigh are weaker than those of the right.

Sept. 15, 1909: The patient and Dr. McLean think that power in arms and hands is not as good as several days ago.

Nov. 15, 1909: Power has steadily but slowly increased in legs and arms. The patient has a good grip, and can raise his hands above his head. He walks fairly well. The left arm and lower extremity are distinctly behind the right in power. In shaking hands with the left, there seems to be a sort of tardy impulse—the fingers do not catch hold for an appreciable fraction of time, one or two seconds.

Plaster removed. A small prominence is apparent at level of axis, and the face is turned to the right. Some motion is present in head, but limitation is present of flexion, of extension, and of rotation. The patient will go without plaster.

Nov. 20, 1909: Skiagram (Fig. 5).

Nov. 25, 1909: Boy walks around, but says his left arm is not as strong as it was. He was knocked over recently.

Nov. 29, 1909: Dating from the fall, the boy has grown steadily worse. His hands and arms are very weak. He is

hardly able to stand, and the power in both hands is distinctly less. A new jacket was applied to-day, similar to the other. When the patient was slung up, a decided attempt was made to reduce the deformity, but without avail.

Nov. 30, 1909: Immediate improvement in power. The patient can again lift his left hand to his head, and his grip, which yesterday registered zero, to-day registers 15. Power in the right hand is also much greater (Norrie).

Jan. 3, 1910: Steady improvement since last note. The patient walks well. He can climb stairs, and has good power in his hands and arms. The knee-jerks are exaggerated. The patient can distinguish heat and cold. No dragging of legs can be perceived.

March 18, 1910: Plaster of Paris jacket removed by request. Boy refuses operation. Excellent power in hands and feet. Knee-jerks are exaggerated. Thickening is present about region of injury. Deformity can be felt in back of throat.

May 20, 1910: Paralysis has steadily and slowly returned. New jacket.

June 20, 1910: Paralysis has steadily and slowly disappeared. Jacket removed.

June 22, 1910: Mixter and Osgood's operation at Metropolitan Hospital. Wound sewn up without drainage. The attempt to anchor atlas over the spinous process of axis was unsuccessful. Therefore with strong silk, the posterior arches were tied tightly together, while the anæsthetist made an attempt to reduce deformity through the mouth. Plaster of Paris was applied from chin and occiput to upper part of chest as formerly.

July 11, 1910: Almost complete paralysis of limbs and of bladder and rectum followed the operation. This has slightly improved. To-day the plaster was removed. The distortion of the head had mostly disappeared, and the deformity at seat of the lesion was much less. Pressure sore under chin. The patient was slung up with Calot sling, and a new collar (jacket) similar to the others was applied, cut out under the chin for the pressure sore.

In July I moved to Denver, but kept in touch with the patient by letter.

July 30, 1910: A letter from the house surgeon of the Metropolitan Hospital says that the patient is gradually improving.

FIG. 7.



FIG. 8.



Photographs of patient taken in April, 1911, ten months after the operation. (Case II.)





Power is increasing in legs and arms, and the control of bowels and bladder is being resumed. The boy sits up for four hours a day.

Sept. 11, 1910: "Benjamin continues to improve. He walks about the ward, and does light work. His right side is normal, but the left arm and leg are weak and tremulous. Improvement on this side is slow."

Nov. 1, 1910: Plaster removed.

Jan. 1, 1911: Left Metropolitan Hospital.

Jan. 12, 1911: Skiagram was taken by Dr. Chas. Eastmond, of Brooklyn (Fig. 6).

Jan. 28, 1911: The patient called upon Dr. Albee, and to Dr. Albee I am indebted for the following notes:

"He walked into the office as if he had never been paralyzed or had broken his neck. He has complete use of his arms. The strength of the forefinger of the left hand is considerably impaired, but the rest of the hand is all right. There is a prominence over the second, third, and fourth spinous processes. The neck is very straight, and the upper normal curvature of the thoracic spine is diminished. There is a compensatory lordosis. The anteroposterior motion is limited, as is also rotation. Motion, active or passive, is not painful. The knee-jerks are somewhat increased, especially on the left side. It is a great case."

Feb. 28, 1911: The patient writes that he goes to school, and is taking up *stenography and typewriting*.

April: Photographs of the patient were taken by Dr. Napier, Figs 7 and 8.

May 20, 1911: The patient was seen by me to-day. He is in excellent condition, can walk and run and climb stairs, and has a good grip with both hands. His head sits practically straight on his shoulders. There is a small knuckle over seat of lesion. The knee-jerks are somewhat increased. No ankle clonus is present. All motions of neck are somewhat restricted.

There are numerous suggestive points in this history: Conservative treatment, tried for about a year, had been a failure, in so far as the cure was concerned, though each time that a plaster jacket was applied the symptoms abated.

The cord, though evidently compromised by the pressure, was not seriously damaged, and resumed its functions as soon

as the pressure was relieved by the slight amount of replacement afforded by the plaster.

The marked preponderance of symptoms on the left side showed that the subluxation had taken place on the right atlo-axoid joint as an axis. In other words the luxation was not a rotary luxation, properly so-called, but the left atlo-axoid joint had parted.

In order to permit this luxation, the transverse ligament must give way, or the odontoid process must slip out from under it, or the odontoid process must be fractured. A study of the two bones makes the last the most probable solution. If the odontoid process held fast it would probably cause instant death from pressure. Other writers have reached the same conclusion.

Although the atlas is decidedly out of place, the anchoring of its posterior arch to the arch of the axis has relieved the symptoms.

Operation is not always hopeless in spinal fractures and dislocations if it be undertaken with a logical idea.

Finally: The patient described in Case I, though apparently cured, is liable to die suddenly at any time by increase of the displacement. This result has been observed in many cases. On the other hand Pilcher's case was alive and practically well nine years after the injury. In our second case it would seem that as long as the silk ligature holds fast, the displacement cannot recur. At any rate, the operation has restored to practical health a patient who could not live without a cumbersome apparatus.

The following articles on spinal fracture will be found interesting:

Thorburn: *Brit. Med. Jour.*, Oct. 27, 1894.

Lloyd: *Am. Jour. of the Med. Sciences*, July, 1889.

Lathrop: *ANNALS OF SURGERY*, vol. xxxii, 1900, p. 834.

Lloyd: *Jour. Amer. Med. Association*, April 13 and 20, May 4, 1901.

Lloyd: *Phil. Med. Jour.*, Feb. 8, 1902.

Burrell: *ANNALS OF SURGERY*, vol. xlii, p. 481.

Walton: *Jour. of Nervous and Mental Diseases*, vol. xxix, 1902, p. 1.

Bolton: *ANNALS OF SURGERY*, vol. xxx, 1890, p. 172.

- Leckie: Brit. Med. Jour., Oct., 1892, p. 786.  
 Mixter-Chase: ANNALS OF SURGERY, vol. xxxix, 1904, p. 495.  
 Thomas: Med. and Surg. Reports of Boston City Hos., 11th Series, Boston, 1900, p. 1.  
 Oliver: ANNALS OF SURGERY, vol. xxxvii, 1903, p. 239.  
 Clark: Med. Record, Sept. 8, 1906, p. 575.  
 Haynes: N. Y. Med. Jour., Sept. 22, 1906, p. 583.  
 Stewart and Harte: Phil. Med. Jour., 1902.  
 Honan: Medical Times, 1900, xxviii, p. 217.  
 Pyle: ANNALS OF SURGERY, 1894, xix, p. 664.  
 Bastian: Med. Clin. Trans., 1890, lxxiii, p. 151.  
 Warren: Boston Med. and Surg. Jour., May, 1899.  
 Starr: Amer. Jour. Med. Sciences, vol. civ, 1892, p. 15.  
 Knapp: Jour. of Nervous and Mental Diseases, Sept., 1897.  
 Phelps: Jour. of Nervous and Mental Diseases, 1893, p. 407.  
 Abbe: Medical Record, March 3, 1900, p. 353.  
 Swan, Powers, and Pershing: Medical Record, vol. lxxix, No. 15.

# THE TREATMENT OF ANEURISM OF THE ABDOMINAL AORTA BY PARTIAL OCCLUSION OF THE AORTA WITH THE METALLIC BAND—THE EFFECT UPON THE URINARY SECRETION OF THIS PROCEDURE.

A REPORT OF TWO CASES.

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THERE are 15 recorded cases of ligation of the abdominal aorta,<sup>1</sup> and one case of ligation of the thoracic aorta.<sup>2</sup> All have ended fatally. The cause of death, according to Katzenstein<sup>3</sup> and to Offergeld,<sup>4</sup> who recently have made thorough studies of the results of aortic ligation, is cardiac failure caused by the terrific strain which this operation puts upon the heart. These investigators agree that the operation is unjustifiable when there is the least question of cardiac or vascular disease.

Healthy laboratory dogs not infrequently may survive complete occlusion of the aorta. When they do so their hearts at autopsy show hypertrophy. Animals withstand, however, a partial occlusion of the abdominal aorta very well (Halsted<sup>5</sup>). Likewise in man a gradual occlusion of the vessel by thrombosis is sometimes survived. These facts have led several writers—Halsted, Keen,<sup>6</sup> Stratton<sup>7</sup>—to suggest gradual occlusion as a method of treating aneurism of the aorta and to contrive instruments for this purpose. The two cases of abdominal aortic aneurism, here reported, were treated by partial occlusion of the aorta by means of the aluminum bands devised by Professor Halsted. In both cases the bands were applied above the origin of the renal arteries. In one of these cases two bands were applied, the first to the thoracic, the second to the abdominal aorta. Thus an excellent opportunity

was afforded for study of the effects upon the urinary secretion of a sudden fall in the blood-pressure of the kidneys. After each of the three operations on the two cases, there appeared for several days in the urine a great number of long waxy casts. This finding was so striking, that it is thought it might prove of diagnostic value in determining the sudden occurrence of obstruction of the aorta above the origin of the renal arteries, or of the renal arteries themselves.

CASE I. (Surg. No. 20092).—E. S., age thirty-six, colored, was admitted to the Johns Hopkins Hospital to the service of Professor Barker, December 5, 1906.

*Complaint.*—Great pain in the upper part and sides of the abdomen, and in the back.

*Family History.*—Irrelevant.

*Personal History.*—The patient had always enjoyed vigorous health up to his present illness. The following facts significant as having a probable causal relation to his trouble: (1) he had had syphilis 10 years before admission; (2) he had used alcohol to excess; (3) he had always done very hard work—teaming and heavy hauling.

*Present illness.*—In July, 1905, while lifting, the patient “felt something give way inside his abdomen.” For a few days following this he had pain in the epigastrium when coughing, but the trouble soon subsided and he continued at work.

On July 4, 1906, at noon, he had a sudden “grumbling, boring” pain in the epigastrium. This pain was constant after the onset. Five weeks before admission it became very much worse. He said that the “jolting of the wagon almost set him wild.” The pain was localized in the abdomen midway between the navel and the ensiform cartilage, and extended thence to the back. It was made worse by coughing, by movement, and at times by taking food. He had lost 60 pounds in the five months prior to admission. It is uncertain just when he first noticed the abdominal tumor, but it was probably about five weeks before admission.

In the few days just before he entered the hospital, the tumor had rapidly increased in size. On the day of admission the pain became so agonizing that he frequently had to stop his team to relieve it. He said that he “finally had to give up.”

*Physical Examination.*—The patient was a powerfully built colored man. The thoracic and abdominal viscera were found to be practically normal. The only thing of significance discovered on physical examination was an abdominal tumor. On December 9 Professor Osler saw the patient and dictated the following note:

"The patient is a robust, muscular looking man. He has no extreme degree of sclerosis. The temporals are scarcely palpable. In the abdomen, in the epigastric region, midway between the navel and the ensiform cartilage a definite swelling is seen. The pulsation itself extends from the ensiform to the navel and from there beyond the right parasternal to the left mammillary line. It looks distinctly undulatory, appearing much more wide-spread than the usual pulsation seen with a throbbing aorta. The costal border is not elevated with pulsation. No pulsation below navel. The visible tumor undergoes no change. There is much more pulsation to the left than to the right of the midline. No pulsation behind. On palpation the abdomen is everywhere soft. Above the navel the patient is tender. Occupying the left side of the abdomen, above the navel, there is a large tumor, pulsating, expansile, outlined definitely between one's hands. Pulsation is very forcible, feeling directly under one's fingers. Has the same characteristic as a cardiac or arterial pulsation. No thrill. Shock of neither sound is palpable. There is a loud, systolic murmur."

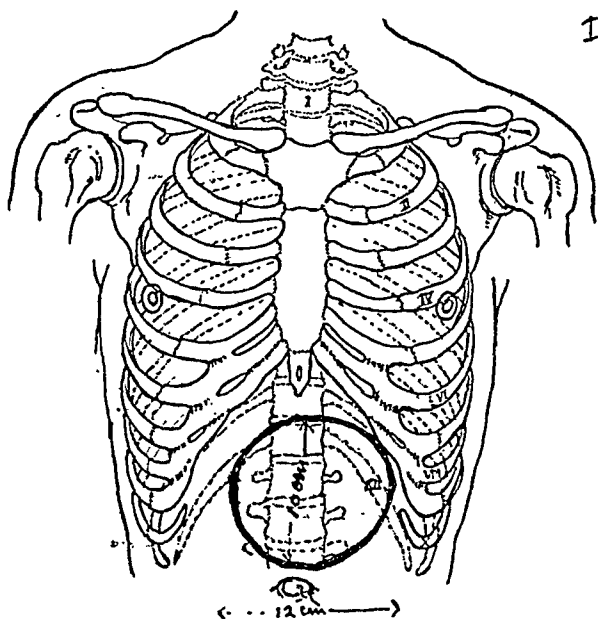
The patient's red blood-cells were 5,000,000, the white cells 6600, and his hæmoglobin 95 per cent. A diagnosis of aneurism of the upper part of the abdominal aorta was made.

On December 17 he was transferred to the service of Professor Halsted, who operated upon him on the 18th, making a partial occlusion of the thoracic aorta with an aluminum band, as near to the diaphragm as was easily feasible.

Operation I: The patient was placed on his back and given ether, his head in a positive pressure box. He was then turned on his side and an incision 36 cm. in length, in the seventh left intercostal space, beginning anteriorly at the costal cartilages and extending almost to the rib angles, was made. The muscles were cut through, keeping near the upper margin of the rib. Practically no bleeding was encountered. After the pleura was opened, the lung was permitted to collapse quite rapidly to a semidistended state. The ribs were then forcibly separated with a

spreader and a wide exposure thus obtained. Fracture of a rib did not occur, but some of the costal ligaments may have been torn. There was no great change in the patient's condition when the thorax was opened, except for an acceleration of the respiratory rate and a quite well-marked fall of blood-pressure. The areolar tissue about the aorta was dissected away and a heavy white braided silk was introduced with a blunt aneurism needle beneath the aorta, possibly at a point to 10 cm. above that at which it passed through the diaphragm. An aluminum band which

FIG. 1.



The aneurism and its relations. (Case I.)

had been previously prepared (of No. 29 sheet aluminum), about 7 cm. in length and 2 cm. in width, with a rounded end, was then made to encircle the aorta. The band was tightened by rolling with the fingers and unrolling prevented by a silver ligature which embraced it. The circumference of the aorta at this point, although not measured, was estimated at 8 or 9 cm.

The patient's blood-pressure at the beginning of the operation was 125 mm. in both arm and leg. After the band was tightened it was 105 mm. in the arm and 55 mm. in the foot.

The operation was performed without the aid of the apparatus for maintaining the distention of the lung. During the closure of the chest the positive pressure cabinet, devised and manipu-



lated by Dr. Richard Follis, was made use of to inflate the lung.

The patient recovered promptly and without incident from the operation. He had neither sensory nor motor disturbance of the legs. The wound healed per primam. The blood-pressure in both arm and leg was taken at frequently intervals. A half hour after the application of the band the pressure in the leg had risen to 100 mm., that in the arm being 120 mm. at the same time. After this the pressure in the leg at times seemed to be equal to that in the arm, though it tended to remain 10 to 20 mm. lower.

The patient's chest was examined on the day after the operation by Dr. C. P. Emerson, at that time resident physician of the hospital, who could find no evidence of pneumothorax. He thought there might be a very slight accumulation of air in the left supraclavicular fossa. The patient was for a time almost completely relieved of pain, some days requiring only 1-12 grain of morphine, whereas before the operation he received large and frequent doses of this drug.

The urinary findings and the relation of the urinary output to the blood-pressure are so important that they will be discussed separately at the end of the history.

Dr. Osler saw the patient a second time on January 1 and dictated this note, which is of interest as showing the effect of the operation on the character of the aneurism.

"There is now a very positive murmur heard over a large extent of the infrascapular region. It is loudest below the scar. Pulsation in the front, that is over the aneurism, is not quite as evident as before operation. The tumor is a more definite one. Its upper border is much more evidenced, it is harder, firmer, and not as tender. No thrill. The murmur is very fine. There is a sharp diastolic followed by a sort of venous hum."

Dr. Halsted on December 21 tested the effect upon the aneurism of pressure on the abdominal aorta above its bifurcation. The pressure was sufficient to obliterate the femoral pulse. It produced a well-marked diminution of pulsation in the aneurism. Careful daily measurements were made of the aneurism. There was found to be no increase in its size. It remained harder than before operation, but had always an expansile pulsation.

The patient's pain, previous to the operation, had been too severe and constant to permit his taking a normal amount of food. He had lost 60 pounds in weight. Now, however, he had a good

appetite and ate without ill effects as much as it was thought wise to give him.

The course of the patient continued favorable till January 4, when pain in the region of the aneurism returned. It also radiated to the right iliac fossa. Large doses of morphine were again necessary. The aneurism began to increase in size. It became softer and lost its definite outlines. By January 10 its transverse diameter had become 14 cm. and its vertical diameter 12 cm. A second operation was therefore done in the hope of relieving the pain.

Operation II. Dr. Halsted, January 10, 1907. Partial occlusion of the abdominal aorta with an aluminum band applied between the bifurcation and the inferior mesenteric artery. Ether anæsthesia.

The abdomen was opened by an incision beginning just below the prominence of the aneurism and a little to the left of the umbilicus, and continued down almost to the symphysis pubis. The intestines were retracted to the right side and pushed upward, and the abdominal aorta exposed to the inner side of the descending colon. One or two small vessels in front of the aorta were divided and ligated with fine black silk. The sheath of the aorta was stripped back, and an aneurism needle introduced beneath the aorta from left to right. This ligature about the vessel was used to draw the artery forward and to free it all the way round for a distance of perhaps 2 to 3 cm. Blunt hooks were introduced at each end of this freed portion, and the ligature was removed. A band about 1 cm. broad and 4 cm. long of aluminum No. 29 was now curled with the bandroller about the aorta. It was then rolled with the fingers until it hugged and constricted the aorta, the cylindrical form being well maintained. Even at this first stage of the rolling with the fingers, the pulsation of the aorta did not tend to unroll the band. The band was again tightened, and until the pulse immediately below it could scarcely be obtained with the gloved finger. The pulse, however, could be felt below the band, but was so feeble that it was impossible to count it and it was necessary to palpate the vessel very lightly to order to appreciate the pulse at all. The pulse in the femoral arteries was obliterated entirely.

The abdominal aorta was perhaps only a fourth or a fifth the size of the thoracic aorta as seen at the former operation. The band

was applied at a point about 4 or 5 cm. above the bifurcation and below the inferior mesenteric artery. Fine black silk sutures were used to close the peritoneum. The muscles and posterior sheath of rectus muscles and anterior sheath and the skin were closed with interrupted silver wire sutures.

The patient again made a good recovery from the operation. He complained on regaining consciousness of a coldness and numbness in the legs, but the sensation in them seemed unimpaired. They could be moved at will. Occasionally after the operation, the femoral pulse was felt and even counted, but only under conditions of exertion, excitement, or pain. The wound healed without infection, notwithstanding the leakage of considerable serous fluid from the peritoneal cavity.

On account of the dressing, accurate observation of the aneurism could not be made for a few days.

On January 17, however, the dressing was pulled down and it was noted that the aneurism had increased in size and that it pulsated more strongly than at any previous time since the patient's admission. On this day the patient's blood-pressure reached 145 mm. Pain was severe.

Nothing of importance happened until the twenty-second. On that day the patient complained of a dull ache in the right side of his chest under the clavicle. On the morning of the twenty-third this pain suddenly became very severe and sharp, and localized itself at the upper border of the sternum on the right side. The patient described it as the cutting of a knife. His pulse became very weak. He complained of a choking sensation and spat up great quantities of frothy mucus. On this day a distinct pulsation was made out in the third and fourth interspaces about 4 cm. to the left of the sternum. This had not been noted before. The patient had no inequality of the pupils, no tracheal tug, and his cough was not brassy. There was no perceptible modification of the percussion note over the sternum. In the region of the pulsation no thrill could be felt. The diagnosis of "dilatation of the arch of the aorta" was made. On the twenty-third also, the patient developed dysphagia, which was complete until the time of his death. He was carefully examined by Dr. W. S. Thayer, who concluded that there was a compression of the base of the left lung and probably a thickened pleura in this region, but no fluid. The hæmoglobin at

this time was 65 per cent.; red cells 3,432,000; white cells, 11,140.

An attempt was made on the twenty-fifth to pass a small sized stomach tube. This reached a point 39 cm. from the teeth, beyond which it could not be advanced. Rectal feeding was resorted to.

On January 28, at 7.10 P.M., he cried out with a sudden sharp pain in the left shoulder. The pain got worse and worse and his pulse became rapid and feeble. At nine o'clock he lost consciousness. He was apparently moribund. An intravenous infusion of salt solution was done, which had a remarkable revivifying effect. He sat up in bed, spat out large amounts of white foamy liquid, and began to cry loudly with pain. At 9.52 he died.

*Urinary Findings and Blood-pressure.*—It has already been mentioned that after the first operation (application of a band to the thoracic aorta) the blood-pressure in two hours was approximately the same in the legs as in the arms. On the day after this operation, December 19, the urinary output was 710 c.c. The urine had a specific gravity of 1034, it contained no albumin, but showed a few waxy casts, which, however, were not observed on any other occasion, although careful examination of the urine was made.

Following the second operation the blood-pressure could never be measured in the legs, for the femoral pulse could only occasionally and then with difficulty be felt. The total daily excretion of urine, and the blood-pressure taken at the same hour each day are charted together in Fig. 2. It will be observed that the total output of urine remained very low until January 19, and, furthermore, that during this period the general blood-pressure, measured at the wrist, rose from 120 mm. to 145 mm. The blood-pressure maintained a comparatively high level until January 22, and during this time the amount of urine was comparatively large. On the twenty-third there was a sudden drop both in the blood-pressure and in the amount of urine excreted.

Unfortunately the voidings for the first two days following the operation were lost, through a mistake of the orderly. They were, however, measured. From this time, however, until the patient's death, a careful examination of a mixed specimen of all the voidings was made daily. A remarkable finding was the enormous quantities of very long waxy casts. These were present until January 20. Many of them measured 1.5 mm. in length. They had ends which presented sharp lines of fracture. Epithelial and granular casts were also present. There was also a trace of albumin. The urine during this time was highly colored and had a tolerably constant specific gravity of about 1030. After the twentieth no casts were found until the day of death, when, after centrifugalization of the urine, a few waxy casts were discovered. It will be noted that the

waxy casts were present during the period of low blood-pressure and diminished urinary flow.

*Autopsy* No. 2837. E. S., age 36 years. Died 9.52 P.M., Jan. 28, 1907. Autopsy 10 A.M., Jan. 29, 1907. Dr. MacCallum.

*Anatomical Diagnosis.*—Aneurism of the abdominal aorta; applications of metallic band to constrict the aorta above and below the origin

FIG. 2.

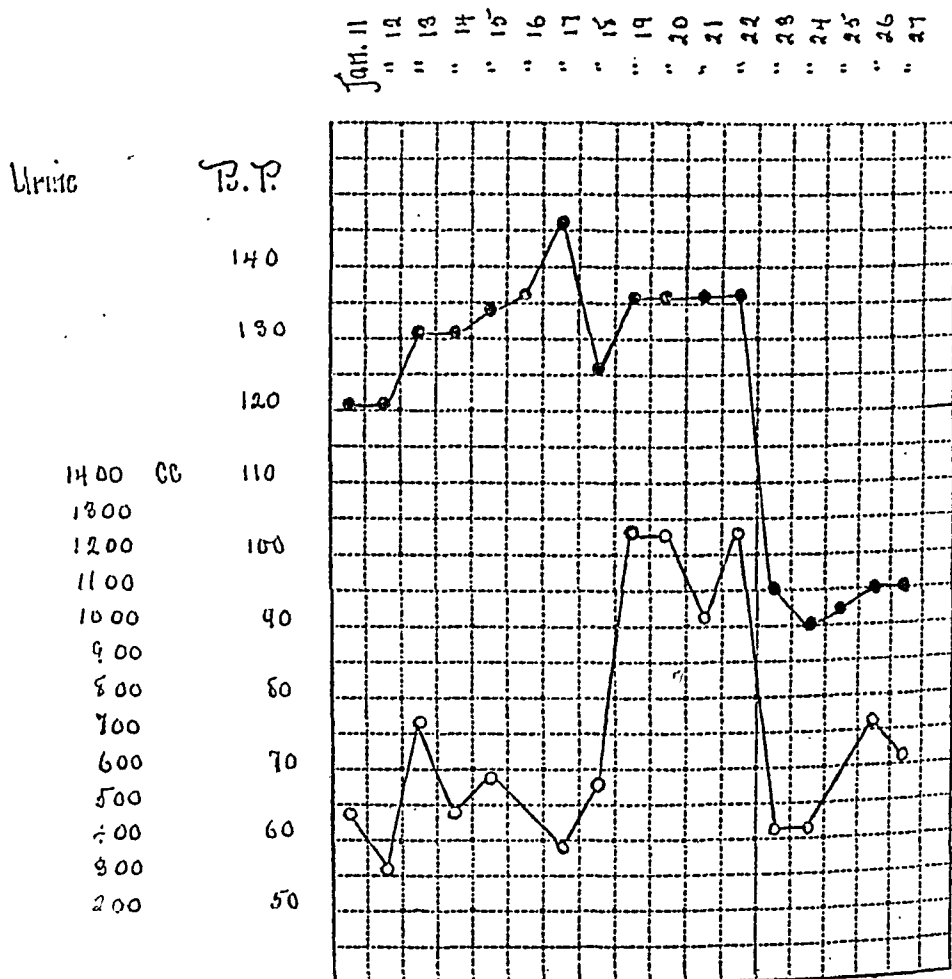


Chart of the daily amount of urine (line with circles) and of the blood-pressure taken daily (line with dots). (Case I.)

of the principal sac; rupture of the aneurism into posterior mediastinum, and into peritoneum; obstruction of the œsophagus; chronic adhesive peritonitis, pleuritis, and pericarditis; thrombosis of two aneurismal sacs; anæmia of the organs; chronic fibrous orchitis, with gumma formation; compression of the lungs.

Body was that of a stoutly-built negro male, 180 cm. in length. Rigor mortis well marked. There was a long scar in the median abdominal line 23 cm. in length. A similar scar 12 cm. in length ran transversely over

the left thorax from the mammillary line to the midaxilla. The pupils were equal, slightly dilated. On attempting to open the abdomen it was found that the intestines were densely adherent to the abdominal wall below the scar, and on cutting through the scar a little pus oozed from the neighborhood of one of the stitches. The peritoneal cavity contained a quantity of bloody fluid. This fluid was not like pure blood, but it seemed to have resulted from the admixture of blood with ascitic fluid. The intestines were everywhere adherent to one another. Over the stomach, between it and the diaphragm, there was a large blood-clot which seemed perfectly fresh. The diaphragm reached the fourth rib on the right side, fifth rib on the left side. The pleural cavities were obliterated by old adhesions. There was no accumulation of fluid anywhere within the thorax. The pericardial cavity was completely obliterated by adhesions, which were loose and easily displaced.

Heart was not enlarged. The cavities contained only fluid blood and post-mortem clots. The endocardium was everywhere smooth. The valves were all delicate and competent. The coronary arteries were slightly thickened. The heart muscle was soft, grayish, and opaque, and very pale.

Lungs: The left lung was tightly bound to the costal pleura and to the pericardium, and could be removed only by tearing through the adhesions. It was not enlarged. On section the bronchi and blood-vessels and bronchial glands were normal. The substance of the lung was for the most part air containing but there were considerable areas of atelectasis. The same description will apply fairly well to the right lung, which was, however, more voluminous and showed fewer areas of collapse. There was no consolidation in either lung.

Spleen weighed 100 mm. It was densely adherent to the surrounding tissues. Its capsule was thickened and dense about the points of adhesions. On section it was very pale, soft, and pasty. The splenic pulp was grayish red in color. The Malpighian bodies and trabeculae were readily seen.

Stomach and duodenum were normal.

Liver measured  $33 \times 19 \times 9$  cm. Was rather soft. There was great elongation of the left lobe which extended far upward over the stomach. The liver was smooth superficially, rather flabby and soft. Section showed the lobulation to be uniform and distinct. The centres of the lobules were quite dark, red, often with an opaque yellow spot, while the peripheral portions were yellowish gray. The gall-bladder was distended with very dark bile. Its walls were normal.

Pancreas and duodenum were flattened out over a projecting mass in the median line, which was as large as two fists. The pancreas was firm and normal in appearance, but rather large. In the anterior portion of this sac-like mass there was a hole with ragged outline, about 1 cm. in diameter, through which a probe passed deeply into the cavity of the mass. Through this hole the blood had exuded into the peritoneum.

Kidneys were about alike, they were large and measured  $13 \times 6.5 \times 1.5$  cm. The capsule stripped with some difficulty, splitting a good deal, but

finally left a fairly smooth surface. On section the cortex was about 7 or 8 mm. in thickness. Its striations were regular and normal in appearance. The right kidney was especially lobulated.

Adrenals were normal.

Bladder and rectum, normal.

Thyroid was normal in appearance, although the left lobe was very small.

Parathyroids were extremely pale, whitish yellow, but normal in consistency.

Testicles were very large, and showed adhesions to the tunica vaginalis so that they could not be stripped free. On section the brownish substance of the testicles was replaced over large patches by pearly white tissue. This was true throughout both testicles. The left contained a nodule, the marginal portion of which was of dense scar tissue, grayish, while the central part was more opaque and brown in color. This nodule measured about 6 mm. in diameter, the scar tissue radiated from it into the surrounding tissue.

Aorta: After removing all the viscera described, it was found that there was a mass about  $15 \times 6 \times 6$  cm. in the neighborhood of the œsophagus, just above the diaphragm and extending chiefly toward the right. A large bougie passed down the œsophagus into the stomach met with a marked obstruction. At a point about 6 cm. above the diaphragm this was passed with a jerk and the bougie passed into the stomach. The finger passed into the œsophagus, reached the ridge projecting from the right side and narrowing the œsophagus. Just below this a metal ring was felt about the aorta, and at a point about 4 cm. above the vault of diaphragm. A similar ring was just above the bifurcation of the aorta, and about the latter there was a great deal of radiating scar tissue. The whole aorta was removed and opened from behind. The iliac arteries were practically normal in appearance. Just above the bifurcation, the aorta was constricted by the aluminum ring to a diameter of about 4 mm., which just allowed a large probe to pass. No very distinct collateral dilatation of arteries was observed. About 2 cm. above the openings of the renal arteries there was a hole in the anterior wall of the aorta, about 4.5 cm. long and 3 cm. wide, which opened suddenly into a large sac. The aorta in general was not sclerotic. There were no patches or roughening, but although somewhat blood stained, its lining membrane was fairly smooth. At the margin of the hole there was absolutely no alteration of the vessel wall, and the orifice of the sac looked as if punched out. The sac projected directly forward, pushing aside the abdominal viscera as described. It was large enough to contain about 800 cc. of fluid, and was partly filled by a laminated thrombus mass as mentioned above. There was a ragged hole in its extreme anterior wall, which allowed the escape of blood. The celiac axis and superior mesenteric artery opened off the front wall of this sac, so that the orifice of the sac occupied the position from which they should have originated. The sac wall was rather thin, inelastic, and fibrous, but not greatly roughened. The sac extended up behind the stomach, and to the right of the œsophagus, against the diaphragm, which it eroded. A

FIG. 3.



Photograph of the specimen. The aorta has been laid open, and is viewed from behind. The probes are in the iliac arteries. The upper band has been cut across and opened; the lower band is intact. The lining of the aorta is smooth and normal in appearance. The openings into both aneurysms can be seen. (Case I.)





perforation had taken place through the diaphragm into the tissues to the right of the œsophagus, and an extensive hemorrhage had occurred into these tissues, so that a large cavity had formed in the posterior mediastinal tissue along side of the œsophagus, and was filled with blood-clot which caused the compression of the œsophagus and the inability to swallow. Above the diaphragm about 4 cm. the aorta was again narrowed by the upper aluminum band, to such a degree as only to admit the tip of the little finger. The band was cut through and spread open, but there was no alteration of the vessel wall visible to the naked eye. The band was healed into a mass of fibrous tissue. Springing from the arch of the aorta there was a second aneurism which projected upward in a symmetrical way from the arch. It was about 5 cm. in diameter, and rounded, and did not compress the œsophagus or trachea. From it the left carotid, subclavian, and the innominate arteries sprang. The aorta round about it was not markedly sclerotic and its own walls, though fibrous and inelastic, were not very much roughened. They were covered in part with a laminated thrombus.

Brain showed no abnormality externally, except a few pin-head sized opacities in the somewhat thickened pia.

Intestines, although adherent to one another, were normal throughout as far as their mucosa was concerned.

Larynx: From between the true and false vocal cords there projected a small pedunculated mass of soft œdematous tissue. This measured about 4 mm. in diameter.

*Microscopical Notes.*—Parathyroid showed the palisade arrangement of the marginal cells. Most of the cells had the finely granular character. There were a good many eosinophiles.

Spleen: The splenic capsule was enormously thickened and fibrous, and showed hardly any cells.

Larynx: One section passed through a small mass of tissue, which was composed of œdematous fibrous tissue, containing mucus secreting glands, and covered with columnar epithelium. This was apparently the nodule seen rising from the vocal cord in the larynx.

Kidney: Microscopical sections of the kidney showed the capsule still in place. The cortex was not particularly distorted, although there were no distinct scars. The glomeruli were normal. The capillaries throughout the kidney were fairly well filled with blood. The epithelium of the tubules was everywhere more or less degenerated. This was especially true of the convoluted tubules in the cortex. The cells were frequently detached from the walls of the tubules and were very ragged and granular. In places they formed mere masses of dislocated cells in the centers of the tubules. Most of these dislocated cells had deeply staining shrunken nuclei while others formed merely a ragged débris. All of the tubules were found to contain a granular and bubble-like material which is frequently seen in various forms of nephritis, and which was apparently coagulated fluid. The vesicle or bubble-like structures which make up this fluid were often found to be in intimate relationship with the epithelial cells. There was no infiltrating exudate of any sort. The cells did not appear to have

accumulated fat globules to any extent. No casts were seen in the tubules even far down in the medulla, except in two tubules where distinct deeply staining casts were seen. These were quite near the papilla. There was no marked œdema of the kidneys, but from the shrinking and desquamation of the cells the whole cortical portion had a rarefied appearance.

**Thyroid:** The stroma was quite abundant and dense. The alveoli were filled with homogeneous colloid. They were lined uniformly with cubical epithelium.

**Testicle** showed an extreme degree of fibrous orchitis. The tubules were completely obliterated through most of the section. At the central part there was a scarred area which was pigmented very much.

**Liver** showed an exquisite chronic passive congestion. Some of the congested areas still showed the remains of necrotic cells.

**Pancreas** was very œdematous. The elements were spread widely apart, but they were otherwise normal.

**Heart:** The pericardium was obliterated by loose connective-tissue adhesions. No remnants of the cavity or of the epithelium were left. The heart muscle was practically normal.

**Aorta:** A section passing through the edge of the aneurism of the arch of the aorta showed a sudden break in the media. The fragment of the media was continued into the wall of the aneurism, but separated from the rest by a cavity which was filled with fluid. A great deal of irregularly arranged scar tissue was heaped around this point of fracture. The intima was enormously thickened. On passing into the sac proper it was no longer possible to distinguish the layers. The wall was made up merely of dense fibrous tissue.

**CASE II (Surg. No. 23652).—S. M. O.,** white, age fifty-three, was admitted to the service of Professor Halsted in the Johns Hopkins Hospital on February 9, 1909.

**Complaint.**—Colic-like pain in the abdomen between the navel and the stomach, inability to digest food, chronic constipation, and great loss in weight and strength.

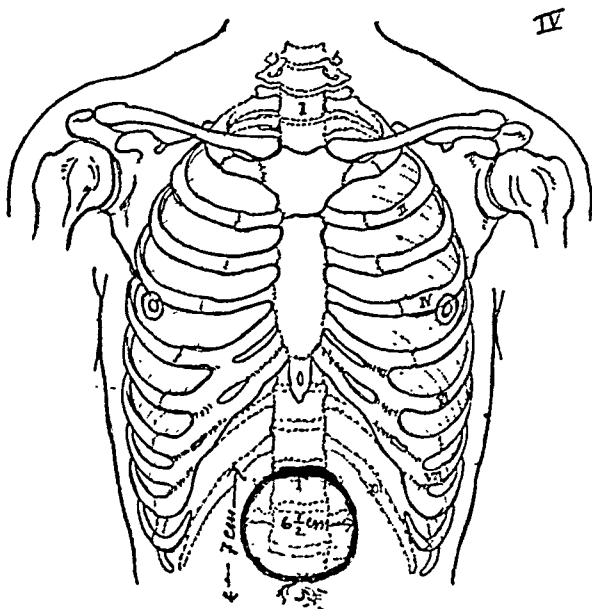
**Family and Personal History.**—Patient had never had any diseases of importance except malaria and dysentery. He had suffered with chronic gastro-intestinal trouble for years. In 1899 he was operated upon for hemorrhoids. This operation caused a slight thread-like stricture of the rectum which had been dilated digitally several times. Denied having syphilis; Wassermann reaction negative. Was a moderate drinker, and used tobacco to excess.

**Present Illness.**—The time of origin of the aneurism is uncertain, as the symptoms therefrom were attributed to the patient's chronic constipation. He had noticed an epigastric tumor for six or eight months. This was regarded by himself and his

physicians as a fecal impaction, and this diagnosis seemed to them to be confirmed by its decrease in size after cathartics and enemata. Pain had been the dominating symptom. This was localized above the navel and in the region of the right kidney. It was made worse by exercise and relieved by lying down. He described it as colic-like, this idea of its character being suggested by its supposed relation to the intestinal trouble. The pain required large doses of morphia, and finally led him to consult Dr. Halsted. His weight had decreased from 190 to 118 pounds.

*Physical Examination.*—The patient was of large frame but

FIG. 4.



The aneurism and its relations. (Case II.)

greatly emaciated. He had emphysema of the lungs and a slight bronchitis. His peripheral arteries were sclerotic. These were the only findings of importance except the abdominal tumor. The abdomen was scaphoid in shape. Its walls moved freely with respiration. No tumor was visible, but marked pulsation could be seen extending from the umbilicus to the xiphoid cartilage. On palpation a tumor could be felt immediately above the navel. This was spheroidal in shape, and was situated somewhat more to the right than to the left of the midline. It could be grasped between the hands, and had a definite expansile pulsation. It did not descend on inspiration. Its right lower quadrant was firmer

than the rest of the tumor, and formed a boss-like prominence, which was very tender. No thrill nor shock could be felt. The vertical diameter of the tumor was 6.5 cm.; the transverse, 7 cm. Between the tumor and the abdominal wall a strip of bowel could be palpated.

The findings on percussion were unimportant. On auscultation a systolic murmur could be heard over the tumor and downward along the aorta and the iliac arteries, but not over the femorals.

Operation I. February 23, 1909, Dr. Halsted; ether anæsthesia. Application of a metal band to the abdominal aorta immediately above the renal arteries.

The following description is a quotation from the notes made by Dr. Halsted a few hours after the operation.

"A long incision from the ensiform cartilage to the lower border of the umbilicus was made through both the anterior and posterior sheaths of the left rectus abdominis muscle, the muscle being split near its inner edge. This incision was made in preference to one in the midline to facilitate stitching and to strengthen the wound. The liver was found to be low, its lower edge in the midline, slightly overlapping the aneurism. The operating board being raised high at the foot, the liver and stomach dropped back into place. In operations upon the abdominal aorta of dogs, it was found very advantageous to tilt the operating board steeply in such manner. The transverse colon was packed upwards, the small intestines and the ascending colon to the right, the sigmoid flexure to the left. The mesenteric fat on the colon was quite dense, being more or less matted to the aneurism. Large veins occupied this fat, and one of these, presumably the inferior mesenteric, was so directly in front of the aorta just above the aneurism and at the point of election for the band, that at first it was difficult to retract it sufficiently to make access to the artery at this point feasible. The pancreas was slightly adherent to the aneurism above and hence I attempted at first to expose the aorta above the pancreas. Such a plexus of veins presented themselves at this situation that I decided once more to try to separate the pancreas from the aneurism. This was accomplished with less difficulty than I had anticipated. At the site elected for exposure of the aorta, the inferior mesenteric vein, the vena cava and the left renal vein were in contact with

each other. Separating them in gridiron fashion, we soon found ourselves in a very deep hole, circumscribed by such large and important vessels that the operating field in its deepest portions could not well be enlarged. These vessels overlapped the upper edge of the aneurism and were put on the stretch by it. Immediately above the aneurism was the left renal vein, flattened from before backwards, and measuring from above downwards about 1.5 to 1.8 cm. From this renal vein at its upper edge and immediately over the middle of the aorta was given off a large vein, which may have been the left inferior phrenic but which did not run directly upwards, its direction being somewhat outwards as well as upwards. This ascending branch of the left renal vein hampered us so much that we finally divided it and then were able to expose at this point the abdominal aorta, but only by retracting downwards with a vein retractor and with some little force the left renal vein. The superior mesenteric artery was not clearly defined in the dissection, but a resistance was experienced to the exposure of the anterior surface of the abdominal aorta to a point higher than perhaps 2 cm. above the upper edge of the left renal vein (before the latter was retracted).

"In attempting to free the aorta we were compelled, therefore, to confine our operations to the immediate neighborhood of the aneurism in the little space between the superior mesenteric artery and the left renal vein which latter was firmly retracted downwards. The freeing of the artery was, therefore, difficult because of the restricted space, the great depth of the aorta, and the large amount of new connective tissue which was formed in the vicinity of the aneurism. The upper surface of the aneurism presented an almost vertical wall about 5 cm. deep, at the foot of which was the aorta. The freeing of the aorta at this great depth and through the gridiron opening bounded by the veins enumerated was accomplished with long, narrow dissectors especially constructed for work in deep confined spaces. These long, delicate instruments proved of great value, for the space in which we were compelled to work would, for a considerable time, hardly admit one finger. Finally the artery was satisfactorily circumscribed, and two tape ligatures passed about it from right to left by means of aneurism needles. After the passage

of these ligatures we endeavored by their aid to expose more of the artery in order to make space for the metal band. The renal arteries prevented dissection downward, and lumbar arteries were encountered above, removed probably not more than 1.5 cm, from the renals. The vena cava, which overlapped the aorta slightly, was at an earlier stage of the operation easily separated from it.

"The depth of the aorta was now so great and the field of operation at its deepest portion so restricted that I feared it might not be feasible to introduce a straight instrument of the width of a bandroller (about 9 mm.) under this vessel. The space was too small to admit of the introduction of two gloved fingers. Removing the glove of the left hand, I palpated very carefully the wall of the aorta at its exposed portion to determine if it would be safe to make considerable traction upon it forwards with the underlying tapes. As there seemed to be no evidence of calcareous degeneration, sufficient traction was made with the tapes to occlude the aorta and greatly reduce it in size. A very carefully filed band (about 5.5 mm. in width, approximately 5 in. long, and of thickness No. 25 of the American scale), was placed in the instrument, and the piston of the instrument pushed forwards until about 4 mm. of the rounded end of the band was exposed at its tip. The loaded instrument was then passed under the aorta until the tip of the band could be seen. The piston being then pushed home and the tapes still drawn upon to occlude the lumen of the aorta, the band was made to encircle the vessel satisfactorily. It was then tightened by rolling with two fingers to the degree desired. The lumen of the aorta was very considerably occluded, as evidenced by the great bulging of the portion above the band, by the softening of the aneurism, and by a thrill which before had not been perceptible. I should think that the lumen was lessened by approximately  $\frac{3}{4}$ ; in other words, reduced to  $\frac{1}{4}$  or  $\frac{1}{5}$  of its original size.

"A thrill, well pronounced, could then for the first time be felt in the aneurism. The pulse in the left femoral artery was almost obliterated, but could in a few moments be distinctly felt, and was at no time uncountable. The peritoneum with the posterior layer of the sheath of the rectus muscle was closed with No. 1 catgut; the anterior sheath of the muscle with a continuous suture of No. 2 catgut, doubled; the deep subcutaneous fascia with a continuous suture of fine silk. Two sutures of silver wire

were taken through the anterior sheath of the rectus in support of the catgut. These did not penetrate the skin. The skin was brought together in the lower half of the incision, where there was tension, with silver wire; in the upper half, where there was none, with fine black silk.

"From the beginning of the operation to the completion of the rolling of the band two hours were consumed; probably  $1\frac{1}{2}$  hours of this time were required for the adequate exposure of the aorta. The operation was one of the most difficult that I have performed. Had it been possible to apply the band below the renals, it would have been tightened until the obliteration of the

FIG. 5.

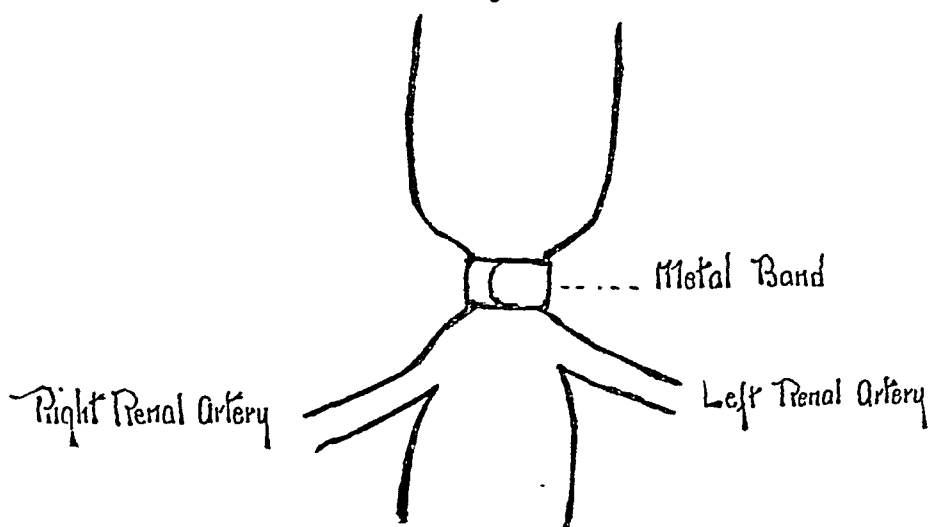


Diagram showing degree of constriction by the band. (Case II.)

femoral pulses was complete and until the pulse below the band was barely demonstrable."

The degree of constriction of the aorta is shown in Fig. 5. The femoral pulse was never entirely obliterated, though for a time it could not be counted.

The wound in the abdominal wall was carefully closed in layers.

The patient made an excellent recovery from the operation. The wound healed per primam. The following note made by Dr. Halsted on March 1, the beginning of the sixth day after the operation, describes the striking change in the aneurism:

"We were surprised to find that the pulsation over the



aneurism is so greatly lessened in force, even after prolonged coughing fits. Indeed, to the right of the scar there is little to indicate the presence of an aneurism, except on deep pressure. Pulsation is most distinct in the concavity just below the aneurism, to the left of the scar. On palpation, no thrill is to be felt either over the scar of the aneurism, or elsewhere in the course of the arteries. One has the general impression that the aneurism is greatly diminished in size."

The character of the patient's pain had changed completely since the operation. He now had a dull continuous ache in the left upper quadrant of the abdomen. The pain was quite bearable, and required but little morphia for its relief.

There was a steady improvement until March 6, when suddenly the patient had a chill, developed a temperature of  $103^{\circ}$  and had sharp pain in the appendix region. From now on until March 23 he had a daily rise to  $102^{\circ}$  or  $103^{\circ}$ . The aneurism began rapidly to increase in size. It became tender and pulsated again forcibly; the cystolic murmur over it, which had practically disappeared, returned. On March 7 the aneurism measured 8.1 cm. vertically and 10 cm. transversely. The patient again required large doses of morphia. Dr. Finney was now called in consultation, and advised wiring of the aneurism.

Operation II. March 12, 1909, Dr. Finney. Ether anæsthesia. Wiring of the aneurism. A small incision was made to the left of the previous scar over the most prominent part of the aneurism. On opening the peritoneum the aneurism presented at once, being covered only by a thin peritoneal coat, containing large blood-vessels, probably the transverse mesocolon. The needle was inserted into the sac through the peritoneum in the space between several of the large mesenteric vessels and eleven feet of wire were passed into the sac through the needle. Ten amperes of current were now passed through the wire for 40 minutes, then 20 amperes for 10 minutes, and then 40 amperes for 10 minutes. After this, the needle was withdrawn, the wire *inverted* and turned into the sac. Bleeding, however, was quite profuse from the puncture wound in the sac and required three Lembert sutures of fine silk to control it. The abdomen was closed in layers. The patient again made a good operative recovery, but the pulsation and growth of the aneurism was apparently but little affected by the wiring. On March 21 it was

observed to have increased rapidly in size and to have grown downward into the right iliac fossa and also downward below the navel. At this time the blood-pressure in the right leg was found to be only 118 mm., whereas in the left leg it was 155 mm. This was interpreted to mean that the aneurism was pressing on the right iliac artery.

The pulsating mass was very superficial and very sensitive to pressure. It looked as if it were pointing and about to rupture at a point just to the right of the umbilicus. The aneurism measured 15 cm. transversely and 12 cm. vertically.

The patient's course from this time until his death was steadily downward and without incident of special importance. Unable to take food, his emaciation became extreme. April 9 he died.

*Blood-pressure and Urinary Findings.*—Before the first operation, the patient's general blood-pressure, measured in the right radial, was 150 mm. His urine contained a few granular casts and a trace of albumin. The chart (Fig. 6) shows the drop in the blood-pressure of the lower extremities which occurred on application of the band and also the comparatively rapid return of a palpable pulse in the dorsalis pedis artery. Unfortunately daily observations of the blood-pressure, *were not* obtained, so that our records are somewhat deficient in this respect. On February 25, however, the blood-pressure in the arm was found to have risen to 190 mm., while that in the legs was 180 mm. On March 6 the blood-pressure had dropped to 130 mm. in the arm. On March 15 it had risen to 170 mm., and just before death it was 110 mm. The pressure was practically the same in the arm and leg, but, as has already been mentioned, it was different in the two legs. Owing to the lack of daily observation, we could not establish so clear a relation between the blood-pressure and the urinary output as in the other case. On the day following the operation, the amount was 600 c.c. On the next day it was 1100 c.c. The amount seemed to depend entirely upon the quantity of liquid ingested. The urine was always of a normal specific gravity. As in the other case, a shower of waxy casts appeared in the urine after the application of the band. These decreased in numbers after the first few days, but a few could always be found.

*Autopsy* by Dr. W. G. McCallum, 9 A.M., April 15, 1909. Surg. No. 23652, S.M.O., age 53 years. Autopsy No. 3202.

*Anatomical Diagnosis.*—Extreme arteriosclerosis; aneurism of abdominal aorta just below the renal arteries; operation for application of metal band above the renal arteries; second operation for wiring of aneurism; occlusion of aneurismal sac by thrombus; infection of tissue about the band; extensive abscess formation in psoas muscle; compression of pylorus and duodenum; partial obstruction by compression of common bile-duct and pancreatic duct; distension of gall-bladder; dilatation of pancreatic duct; atrophy of pancreas; compression of right renal artery;

compression of inferior vena cava below right renal vein; complete thrombosis of vena cava and branches up to the right renal vein; anæmia; atrophy of right kidney; phleboliths in spleen, kidney, and liver; emphysema of lungs; extreme emaciation.

The body was that of an extremely emaciated old man, 175 cm. in length. There was a small decubitus ulcer over the sacrum. In the mid-line of the abdomen there was a long linear scar. A little to the left of this there was a shorter scar which was also linear in shape and per-

FIG. 6.

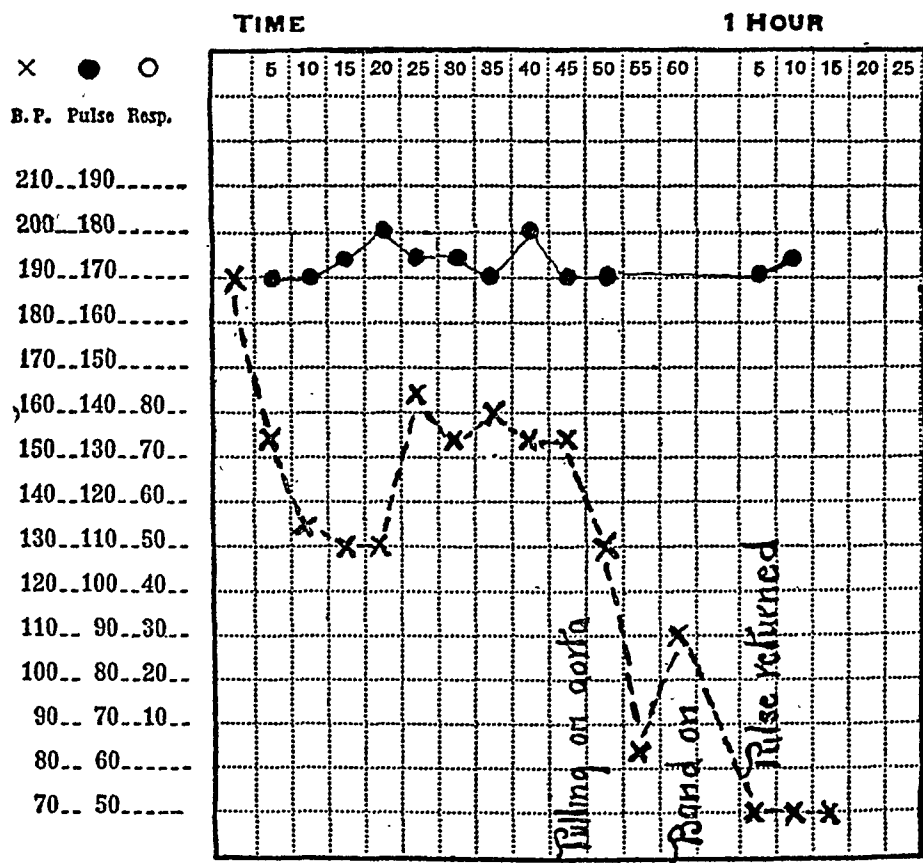
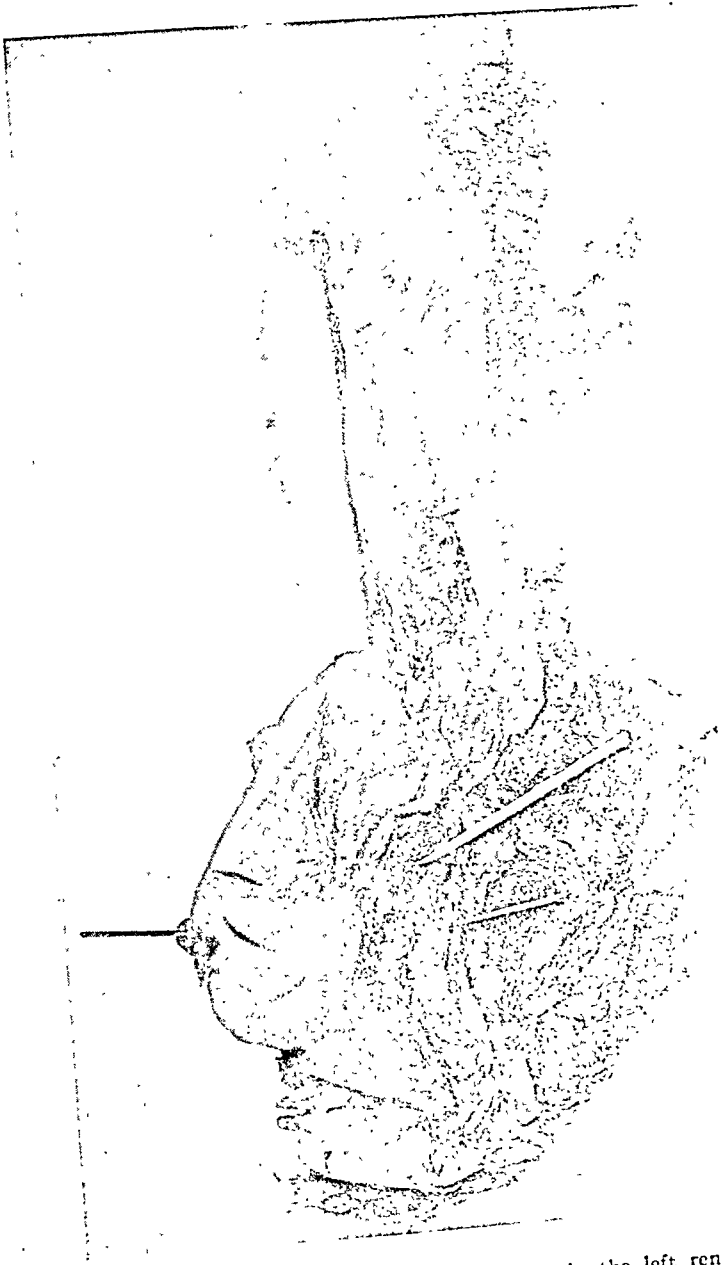


Chart of the pulse and of the blood-pressure (taken in the dorsalis pedis artery) during the operation. (Case II.)

fectly healed. In the midline just above and about the umbilicus there projected a large, rounded mass about 15 cm. in diameter. On opening the abdominal cavity, the peritoneum was found to be adherent to this mass. The peritoneal cavity was dry. The intestines were collapsed and lay far down within the pelvis. The transverse colon lay just above the tumor mass and was not especially adherent to it, but was attached rather loosely to its mesentery. The stomach was small. It was stretched up over the upper surface of the mass so as to arch above it. The duodenum encircled the projecting mass and was apparently somewhat compressed by it. The pylorus lay directly at the upper pole of the tumor. Between

FIG. 7.



The interior of the aorta seen from behind. A probe in the left renal artery. The band is immediately above it; the opening into the aneurism immediately below the artery. The aorta shows an extreme degree of degeneration. (Case II.)



the tumor and the liver there was a great band of tissue that held the enormously dilated common bile duct with the portal vein and the hepatic artery. The gall-bladder was greatly distended. Bile could be squeezed through the very much flattened duct, which lay stretched over the surface of the tumor. Just above the tumor mass the common duct widened out to a circumference of about 3 cm. The cystic duct was greatly dilated, and the gall-bladder greatly enlarged. It was 12 cm. in length. The pancreas was flattened out over the surface of the projecting mass. Its surface was nodular and rough. The pancreatic duct opened freely at its papilla side by side with the bile-duct. It was, however, somewhat flattened out by being stretched over the surface of the tumor. On following it back to a point where it was no longer stretched by the pressure, it was greatly dilated and filled with a turbid grayish fluid. It measured about 2 cm. in circumference. The pancreas was somewhat atrophied about this dilated duct, and formed merely a wall which was about 5 cm. in thickness.

The heart, stomach, œsophagus, aorta and kidneys were removed in one mass and dissected afterwards. It was found that the mucosa of the duodenum was not particularly abnormal. That of the stomach was hyperæmic with some hemorrhages and a few minute erosions. The œsophagus was normal. On removing the aorta and kidneys a fluctant mass was found occupying the position of the right psoas muscle. When cut into, this was found to be composed of a large sac filled with reddish gray, thin purulent fluid. The finger passed up in this cavity quite far behind the right kidney and against the second, third, and fourth lumbar vertebræ. An attempt to remove the aorta from the vertebræ revealed an infiltrated condition of the tissues in front of the vertebræ. They were not, however, eroded of their actual bony substance. The back of the aneurismal sac lay directly upon the abscess cavity in the psoas muscle, and the remaining tissue of the psoas muscle was not sufficient to separate it completely from the abscess cavity, so that apparently this abscess cavity was partly covered in front by the back of the aneurismal sac. Further inspection of the back of this aneurismal sac showed that canals full of purulent material burrowed about in its surface and extended upward towards the aluminum band which was put on at operation just above the renal arteries. The aneurismal sac, however, was not actually opened in being removed, but, found in contact with the vertebral column, its wall was so thin as to be very readily torn through—in fact so thin as to be only with the greatest difficulty maintained intact. Wire was felt projecting from the sac up against this extremely attenuated wall. The aorta was then opened from the back, and it was found that there was a large opening immediately below the renal arteries extending to a point 5.5 cm. above the bifurcation. The opening measured 4 cm. vertically and 3 cm. in transverse diameter. It was quite clear cut. The aortic wall turned over into this aneurismal sac, but became greatly altered after a short distance. The sac itself extended quite far about and below this opening, so that it overlapped the bifurcation of the aorta and extended at least 3 cm. above the orifice of the renal artery. The right renal artery was

stretched out over the top of the sac. The left renal artery was not particularly altered. The aluminum band, which was 9 mm. wide, had been put on just above the renal arteries, not more than 3 mm. above the right renal artery. It was situated just below the superior mesenteric artery, missing it by 5 mm. It had caused a marked constriction which did not admit the tip of a little finger and had healed quite well. It lay in a little cavity in the tissue which apparently communicated with the pus containing canals described above. There was also some blood in this space, and when the constricted area was cut through, it was found that there was a tiny hole in the back wall of the aorta through which the bone was visible. Evidently the constriction was sufficient to keep the blood from escaping. The wall of the aorta at this point seemed to be in part cut through. The intima appeared to be intact, but the media seemed to be completely eroded away by the band. Above and below the band, the aorta was extremely sclerotic and very much deformed. There were various patches which were quite translucent, and were extremely soft and gelatinous as if filled with fluid, while in other areas there was a distinct deep erosion. The ragged edges of the ulcers were covered with soft débris. Elsewhere the wall of the aorta was very irregularly studded with thickened patches. The arch of the aorta was also sclerotic. Below the opening of the aneurismal sac there were also extensive patches of sclerosis and some calcification just at the bifurcation. When the sac itself was cut through, it was found that the lumen was almost completely obliterated by a firm, spongy clot through which the wire extended in every direction. Anteriorly the wall of the sac was fairly thick, but posteriorly it was very much thinned out. The inferior vena cava was completely thrombosed up to the level of the right renal vein, which was enormously distended. Above that the vein was open. It was much compressed and flattened by the pressure of the aneurismal sac. The portal vein was not especially affected. The aneurismal sac measured about 11 cm. in vertical diameter, by 8 cm. in anteroposterior diameter.

Kidneys: The left kidney measured  $11 \times 5.5 \times 4.5$  cm. Its capsule stripped off smoothly, leaving a reddish gray surface, somewhat deeply lobulated. The cortex measured 5 mm. in thickness. Its striations were rather indistinct. The kidney had a rather translucent appearance, mottled grayish dark red. The right kidney was smaller, measuring  $10.5 \times 5.5 \times 3.5$  cm. Its capsule also stripped off fairly smoothly. The kidney was more anæmic than the other kidney. In places the cortical surface seemed to be especially atrophic and thinned out. At one point there was an irregular, reddish patch with opaque yellow spots in its central part which extended deep into the substance of the kidney, and in which the striations and general markings of the kidney were lost. In the thinner parts of the cortex this was true also.

Heart: The pericardial cavity contained no excess of fluid. Its surfaces were quite smooth. There was a curious watery atrophy of the sac. The heart was small. The coronary vessels upon the surface were sclerotic and tortuous. The valves were delicate throughout. The heart muscle was quite soft and mushy, of a reddish brown color.

Lungs were enormously distended with air and extremely cushiony. They were smooth superficially and quite uniformly distended. They were very dry and pale on section.

Spleen: Similar nodules to the ones in the liver were seen on the surface of the spleen. It measured  $15 \times 7 \times 4.5$  cm. It was fairly firm. On section the splenic substance was dark red. The Malpighian bodies were inconspicuous, and small yellowish white nodules were found scattered throughout.

Liver was not enlarged, measuring  $24 \times 19 \times 9$  cm. The surface was smooth. It was dark grayish red in color. The bile-ducts were greatly distended throughout the whole liver. Many of them contained soft, granular concretions. The liver was not bile stained in general, but slightly so about the bile-ducts. The lobules were extremely small and indistinct, rather homogeneous, grayish red in color. The liver contained a number of small semitranslucent nodules about 2 to 3 mm. in diameter.

Bladder (urinary) contained a little turbid urine. Prostate was not enlarged. The mucosa of the bladder showed some hemorrhages and a great deal of hyperæmia. There was no ulceration or very distinct evidence of infection. The mucosa of the rectum was congested in certain areas. No very distinct scars could be made out in any part.

Intestines were deeply injected through the lower portion. The colon was injected in patches and at one point there was to be seen a small polypoid elevation, but there was no ulceration of the intestinal mucosa.

*Microscopical Notes.*—Kidney: In the surface of the cortex of the left kidney at one point there was a small, necrotic, fibrous mass which was surrounded by granulation tissue, in which giant-cells occurred. The cortex of the kidney was somewhat distorted by the presence of the scars which ran irregularly through it. It showed numerous obliterated glomeruli and many shrunken tubules, but there were patches here and there in which the tubules showed apparently compensatory hypertrophy. The whole picture was that of chronic diffuse nephritis. The glomeruli for the most part were pretty well preserved. The tubular epithelium was very well preserved in the tubules which were still extant, but the tubules were filled with this same granular, vesicular material that was so commonly seen in them. There were a few casts in the cortical portion and very little desquamation of epithelium. There were some small cyst-like structures in the cortex which were filled with colloid material. These were apparently glomerular capsules in which the tuft sometimes appeared flattened out against one side, in other cases it did not appear at all. Even in the papillary portion of the kidney there were extremely few casts. Those that were found, however, were dense in appearance, and contained much cellular débris. Section of the right kidney showed extraordinary concentration of the glomeruli which seemed to lie embedded in a dense fibrous tissue containing hardly any tubules. Here and there, however, there were patches in which the tubules were grouped together. The kidney did not contain many casts, but there were a few in the pyramidal portion. These were hyaline in character. The epithelial structures were



pretty well preserved as far as any recent changes were concerned, but of course the enormous atrophy existed as a result of a long continued pressure. Another section of the same kidney showed numerous areas in which there was an abundant round-cell infiltration and an infiltration with polymorphonuclear leucocytes. These areas had almost the appearance of abscesses in places. A good many bacteria could be seen in the kidney also, especially in the areas where the tubules were filled with leucocytes. The greater part of the kidney, however, was shrunken and fibrous. In the pyramidal portion in this section there were numerous casts of a hyaline character.

Lung showed advanced emphysema.

Aorta: The gelatinous plaques found in the aorta were composed of necrotic material full of cholesterolin crystals representing exaggerated examples of the ordinary type of arteriosclerosis.

Pancreas showed atrophy of its substance so that the lobulation was very much accentuated. It showed, however, much more than this. There was an infectious process going on throughout the pancreas which produced extremely interesting changes. All of the ducts of the pancreas were infiltrated with leucocytes. They were almost collapsed by the invasion of the leucocytes outside the epithelium. The whole pancreas was thickly infiltrated with leucocytes which here and there formed accumulations which looked almost like abscesses. The process, however, was very diffuse. The islands of Langerhans were at least free, and in fact were generally free from any infiltration. Another section of the pancreas showed a very similar change. This section was apparently taken quite far out. In the portion of the pancreas right over the aneurismal sac was very marked compression, but the infectious process was not so distinct.

The aorta just at the point of application of the band showed as elsewhere marked arteriosclerosis. The media, which was pretty well preserved and infiltrated with leucocytes, suddenly became necrotic, and exactly through the region of the compression by the band it was completely devoid of nuclei. On either side it was well preserved. The intima in its innermost layers showed nuclei all the way across, but many of these were fragmented. There were some hemorrhages and a great deal of leucocytic infiltration in the tissues about the area.

Liver showed no marked changes except what might be a senile atrophy. There were a few small scars. In one place there was a necrotic nodule surrounded by fibrous tissue. Section through the femoral vein showed a beautiful organizing thrombus.

REMARKS UPON CASE I.—The patient survived the first operation forty-one days, and the second eighteen days. The first operation checked for a time the growth of the aneurism and relieved the patient's pain. The benefit of the second operation was problematical. It was performed because the patient's condition was becoming less favorable.

The blood-pressure in the legs quickly rose to its normal level after the application of the upper thoracic band. The aneurism probably received most of its blood supply from below. This view is supported by the fact that there was diminution in the force of the pulsation in the aneurism when pressure was made on the aorta just above its bifurcation, and also by the considerable disturbance of the urinary secretion which occurred after the application of the second band.

There was no impairment of sensation and no demonstrable loss of muscular power, though the aorta had been constricted both above the diaphragm and at its bifurcation. Obviously tests of the patient's ability to walk could not be made.

We have noted that the second band diminished the blood supply to the kidneys. That after a time the circulation was properly re-established is made probable by the fact that the urine became normal in amount and in quality. The return to normal was coincident with a rise in the central blood-pressure, which rise may have been due in part to the disturbance of renal function and in part to the constriction of the aorta. Katzenstein and Offergeld have shown that ligation of the aorta, even below the renal arteries, causes a rise of blood-pressure.

REMARKS UPON CASE II.—The patient lived forty-five days after the application of the band to the aorta, and twenty-eight days after the wiring of the aneurism. In this case also the constriction of the aorta caused no symptoms which were disquieting either to the surgeons or to the patient. There was no evidence of impairment of the blood supply to the spinal cord or to the legs. The operation caused a striking decrease in the size of the aneurism and a great diminution of the pain. It is to be noted that this aneurism was very well suited for operative interference, since it was saccular and gave origin to no important vessels.

*The Significance of the Waxy Casts in the Urine.*—Emerson<sup>8</sup> states that waxy casts "occur in any nephritis with granular casts, especially when the urine is diminished, or just before death," and that "they are probably a further modifica-

tion of the granular detritus of epithelial cells." Brugsch and Schittenhelm<sup>9</sup> agree with the latter statement. Two factors would thus seem necessary for the appearance of waxy casts: an injury (toxic, mechanical) of the renal epithelium, and a scanty flow of urine. Old granular casts, moulded directly from epithelial débris, probably become changed into waxy casts when compelled to remain a long time in the urinary tubules because of a diminished secretion of urine. Now the application of a band to the aorta, so as greatly to decrease the blood supply to the kidneys, brings about the conditions just described.\*

From the observations made in these two cases we may conclude that the presence of the large waxy casts in both was due to the diminished blood supply to the kidneys, brought about by the constriction of the aorta; in the second case this constriction was just above the renal arteries, but in the other, first of the thoracic aorta, and then of the abdominal aorta below the origin of the inferior mesenteric artery. The autopsy findings in Case II, in which the right renal vein was enormously distended, lend some support to this supposition. In this case the constant presence of the casts in the urine, even after the restoration of the normal blood supply to the organs below the band, is probably to be attributed to the obstruction to the vessels of the right kidney. This kidney at autopsy showed marked degenerative changes.

#### CONCLUSIONS.

1. The pain of an abdominal aneurism may be greatly lessened and its growth checked by the application of a partially occluding metallic band to the aorta, proximal to the aneurism. When the aneurism is saccular and gives origin to no important vessels a cure is possible by this means.

2. When the band produces an anæmia of the kidneys,

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\* For the effect of temporary occlusion of the renal vessels, see the article by Eisendrath and Strauss in the *Journal of the American Medical Association* for Dec. 31, 1910.

there appear for a time large numbers of waxy casts in the urine.

3. It is suggested that the sudden appearances of these casts might, in the absence of other demonstrable causes, be considered as possibly indicative of an obstruction to the circulation of one or of both kidneys.

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- <sup>1</sup> Matas: Article in Keen's Surgery. Vol. v (1909), p. 313.
- <sup>2</sup> Guinard: Revue de Chirurgie, Feb. 10, 1909.
- <sup>3</sup> Katzenstein: Archiv für klinische Chirurgie, vol. lxxvi, p. 58. Katzenstein gives a complete bibliography, and reports all the cases of ligation of the abdominal aorta up to the date of his article. Offergeld and Keen likewise report these same cases.
- <sup>4</sup> Offergeld: Deutsche Zeitschrift für Chirurgie, vol. lxxxviii, p. 217.
- <sup>5</sup> Halsted: Journal of the American Medical Association, Dec. 29, 1906; Bulletin of the Johns Hopkins Hospital, 1905, vol. xvi, p. 346; Trans. Am. Surg. Assoc., 1909 and 1910; Journal of Experimental Medicine, vol. xi, No. 2, 1909.
- <sup>6</sup> Keen: American Journal of the Medical Sciences, Sept., 1900.
- <sup>7</sup> Stratton: Journal of the American Medical Association, March 10, 1906.
- <sup>8</sup> Emerson: Clinical Diagnosis, Edition 1, p. 259.
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# NEGATIVE TENSION DRAINAGE IN THE TREATMENT OF EMPYEMA.

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It is still necessary to preface one's remarks upon the treatment of thoracic empyema with an exhortation to the general practitioner to be more diligent in the pursuit of this condition. Early diagnosis secures for the patient a better prognosis as to life, and, in practically all cases, insures him against the discomfort of prolonged dressings and the exhaustion and dangers which attend chronic suppuration; not to mention the lesser evils of deformity, permanent restriction of the respiratory function, or the distress which enforced idleness frequently entails.

As the vast majority of empyemas are of the metapneumonic type, it should be the habit of the physician, as soon as a diagnosis of pneumonia is made, to have constantly before him the possibility of the development of this complication. A delayed crisis or a renewal of the temperature after crisis, the occurrence of chills and sweating, or the detection of any change in the physical signs, such as the presence of movable dulness or cardiac displacement, should immediately arouse suspicion. When such a suspicion is aroused, persistent efforts should be made to locate the pus. The one reliable method of investigation at this juncture is the use of the exploratory needle. A single negative puncture should not salve the conscience of the attending physician, as it does not relieve him of responsibility should the symptoms continue. With the aid of one of the many local anæsthetics, multiple punctures may be performed without discomfort to the patient, and there are few regions of the chest which may not be thus explored with discretion, including even the danger

zone—the costodiaphragmatic triangle below the eighth rib. Fortunately the majority of empyemas may not escape the searchings of the exploratory needle. Exceptions there are, of course, notably the mural forms of empyema, which are not infrequently secondary to marginal or peripheral lung abscess; small interlobar collections; and those cases in which the pus is located between the diaphragm and the base of the lung, which, especially in children, are frequently characterized by a train of symptoms pointing to peritoneal rather than pleural infection. In cases where an early diagnosis is established we may now with certainty prevent the occurrence of chronic empyema.

As Doctor Hill and I were able to show in our experiments upon rabbits and dogs, intrathoracic cavities, equivalent in area to the space occupied by the whole or part of one lung, are readily obliterated by compensatory changes in the remaining pulmonary tissue, deflection of the mediastinum and its contents towards the cavity, and upward retraction of the diaphragm; providing always that the tension within the cavity is less than the average intrapulmonic tension—in other words, is a negative tension. In the obliteration of an intrapleural cavity following acute empyema, the aid of the same physiological and physical agents may be invoked to secure a similar rearrangement of the anatomical structures forming the walls of such a cavity.

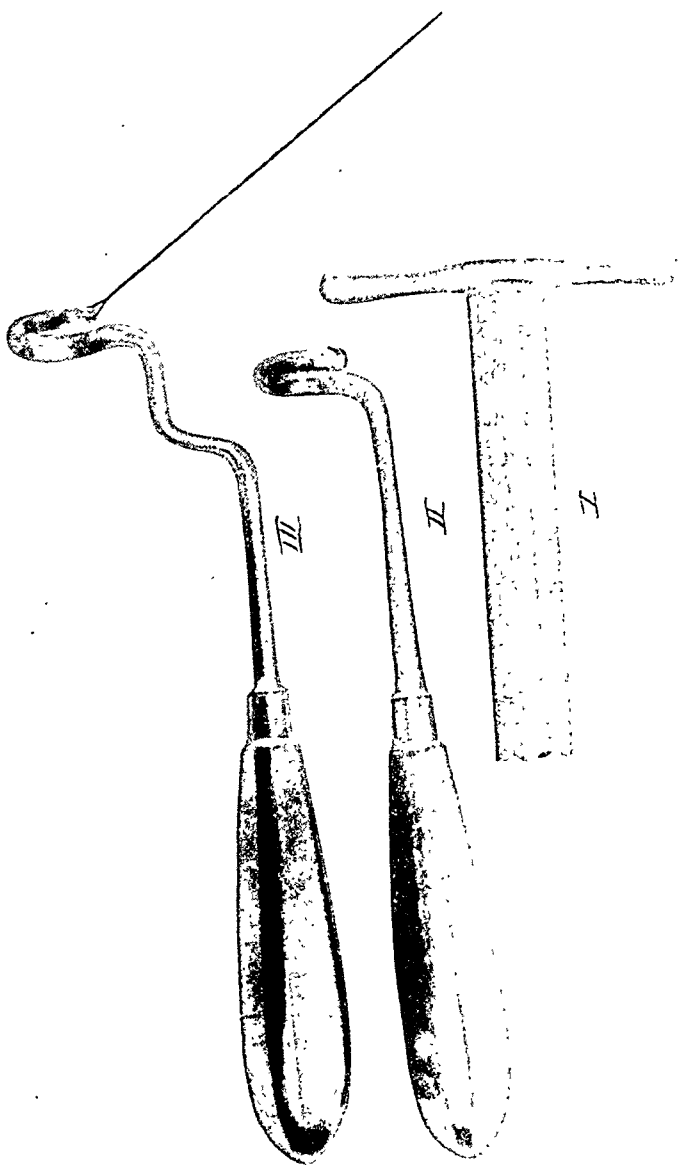
The indefinite persistence of an intrapleural cavity following free and dependent drainage of an empyema (other than tuberculous) is invariably due to pneumothorax. Under ordinary conditions an empyemic cavity is directly exposed to atmospheric pressure at each dressing, and this pressure persists until saturation of the dressings prevents further ingress of air, while permitting the escape of both air and pus during coughing or forced expiration. By this slender means a certain degree of negative tension is developed within the cavity during inspiration; the granulating pleuræ in the peripheral zone of the cavity are brought together and adhere; granulous retraction further coopts the separated pleuræ until the

whole cavity is, in the majority of cases, finally obliterated, not because of the inherent tendency of the lung to expand in the face of atmospheric pressure, but because of the inherent tendency of granulation tissue to contract, and because of the periodic respite from atmospheric pressure afforded by the pus soaked dressing.

Until recently surgeons have looked upon the establishment of efficient drainage as the one important consideration. Too little attention has been bestowed upon the physiological aspect of the problem. Numerous writers upon the subject of empyema have, even within the last five years, insisted upon the inherent tendency of the lung to expand in the face of atmospheric pressure. Although sporadic efforts have been made from time to time to excite the interest of the surgeon in the mechanism of the respiratory function and its important bearing upon the treatment of thoracic empyema, the spirit prior to 1909 was all in favor of compelling the chest wall to conform to the lung, rather than the lung to the chest wall; the one universal concession to the physiological being in the form of pus soaked dressings.

Among the early disciples with a physiological bent should be mentioned Buelau, who in 1891 reported the successful use of intercostal siphon drainage. This method undoubtedly produced a certain degree of negative tension within the empyemic cavity and, in the inventor's hands, proved efficient in preventing pneumothorax. A distinct advance upon this method, that of continuous aspiration, was first suggested by Perthes, and is still practised in European clinics. In its application Perthes performed a preliminary resection of the rib. Continuous aspiration was effected by connecting the drainage tube with a Bunsen water pump. Hutton in 1898, Baylor in 1899, and Williams in 1900—all English writers—described an air-tight dressing fitted with a valvular mechanism which permitted the escape of pus and air during forced expiration or coughing. Still later, Thiersch employed the valve principle by attaching to a catheter introduced between the ribs a section of thin rubber tubing, which collapsed during

FIG. 1.



I, circular knife; II and III, periosteal elevators notched for Gigli saw.



FIG. 2.

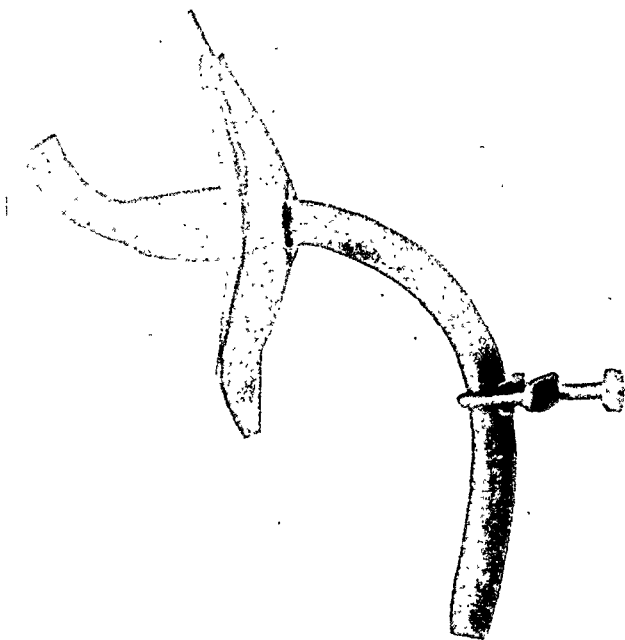


Recent scar following circular incision.



Moulded drainage tube and glass collecting bulb. *a*, drainage openings; *b*, tapered rubber cone fused with tube; *c*, oval felt pad  $4\frac{1}{2} \times 8$  cm., smeared on inner surface with carbolated zinc ointment; *d*, square flange of dentist's rubber dam  $8 \times 11$  cm., with small central perforation; *e*, oval re-enforced rubber shoulder  $4\frac{1}{2} \times 8$  cm., with central vulcanized rubber spool to give added stability to the dressing and support to the drainage apparatus; *f*, valve for occlusion of tube while bulb is being changed; *g*, glass collecting bulb; *h*, lower valve to permit of exhaustion of cavity and bulb.

FIG. 4.



Drainage tube with parts arranged for insertion. The square rubber flange is fixed to the skin by means of four strips of zinc oxide plaster (warmed), the upper and lower strips embracing the two poles of the outer shoulder piece. A roller bandage completes the dressing. When the dressing is being changed, the skin should be smeared with zinc oxide ointment and the excess wiped off before adhesive strips are reapplied. If the discharge is profuse, capillary leakage may occur for the first two or three days, but pneumothorax is absolutely prevented. The upward turn of the inner extremity of the tube is designed to prevent painful pressure upon the diaphragm or lung. As the inner wall of the cavity approaches the chest wall, a tube with a shorter projection beyond the cone is employed. If there is no danger of pocketing, the tube may be cut off at the apex of the cone.

Print from skiagram of Case I (right posterior view), showing upper thoracic cavity at "a"; also upward retraction of the diaphragm under negative tension

FIG. 6.



Print from skiagram of Case I after injection of bismuth paste, showing extent of remaining sinus, and lowered position of diaphragm.

FIG. 7.



Print from skiagram of Case II (left anterior view), showing the marked deflection of the mediastinum (pericardium) to the left, the apex of the heart shadow touching the left lateral plane of the thorax.

inspiration and prevented the entrance of air into the thorax. Unfortunately all these appliances fail to maintain a partial vacuum for more than a few days; and while intermittent siphonage or aspiration is a vast improvement upon the wholly defective mechanism of the pus soaked dressing, the aim of all such appliances is to secure absolute and continuous air-tight closure.

So far as I am aware, but two methods of drainage have been described which are efficient in preventing pneumothorax, namely, that of rib trephining, described by Dr. Samuel Robinson of Boston in the October number of the *Boston Medical and Surgical Journal*, and that which I described in the *ANNALS OF SURGERY*, October, 1910.

In applying the dressing which I have devised, from two to three centimetres of the rib are resected under local anæsthesia before the pleura is opened. For this preliminary thoracotomy I have found the following method to be the most satisfactory. Instead of the usual linear incision, the skin opening is made with a circular knife (Fig. 1); the muscular layers are divided in the long axis of the rib; and flaps of periosteum are raised. The posterior reflection of the periosteum is then separated from the rib by one of the instruments shown in Fig. 1 (II and III), which are provided with a notch for threading a Gigli saw. In place of rib shears, which produce unnecessary injury to the bone, the wire saw is used to remove the desired length of rib, and the cancellous tissue of the exposed rib stumps is plugged with Horsley's wax. No skin sutures are employed. I find that by this method wound infection is less pronounced, and that granulous retraction is so rapid that a smaller tube is firmly grasped within a few days. The scar resulting from the circular incision is very much less marked than that resulting from the linear incision (Fig. 2).

The drainage tube now used is, in several minor details, an improvement upon that first devised (Figs. 3 and 4).

Before the thorax is opened, all parts of the tube should be put together with the lower valve closed, in readiness for prompt insertion. The posterior reflection of the periosteum

and the parietal pleura are then incised and the pus is allowed to escape. As soon as there is a tendency for air to enter the thorax, the wound should be plugged with the finger during inspiration. In many cases the patient can render assistance by forced expiratory movements with the glottis closed and by holding the breath in expiration at the moment the tube is inserted. After insertion, the tube is held firmly against the chest wall while the adhesive strips are adjusted and a gauze bandage is applied. The nozzle of a collapsed Politzer bag is then inserted into the tube below the lower valve, and this valve is opened. If this manœuvre is repeated, the contents of the empyemic cavity may be exhausted wholly or in part, leaving the cavity under negative tension. For the first twenty-four hours, at least, this tension should not exceed the pressure of ten millimetres of mercury. Too great a negative tension produces bleeding from the visceral pleura; or, in cases where rapid re-expansion of the lung takes place, pocketing may occur. In the early stages the Politzer bag or other means of aspiration should be applied each time the collecting bulb is changed, and later on at regular intervals. Negative tension within the cavity not only promotes outward expansion of the lung, but to an exactly equivalent degree tends to hold the dressing in apposition with the chest wall, so that drainage of the operation wound actually takes place into the empyemic cavity.

Where cyanosis is marked at the time of operation, and in cases of double empyema, the use of a positive pressure mask, such as that previously described, is indicated.

Usually within twenty-four hours after the application of this dressing the discharge changes from purulent to seropurulent, and the serous exudation thus promoted tends rapidly to eradicate the infection.

In subacute or chronic cases obliteration of the cavity is, of course, much less rapid, but so long as there is tidal air in the cavity, such a dressing should be employed. In fact the presence of tidal air is an indication that the lung is capable of further expansion. This fact is exemplified by Case I.

In cases of pyopneumothorax, the whole or part of one lobe may be completely collapsed and airless, and even hyper-pressure with the mask may be found quite ineffective in producing re-expansion. In these cases there occurs a rapid infiltration of the collapsed alveolar walls with connective-tissue cells, and where this alveolar fibrosis is advanced, the lobe or portion of the lobe may be permanently lost as a respiratory organ. That obliteration of the cavity after drainage may, however, be effected is well illustrated by Case II.

Among other advantages of this method of treatment may be mentioned the infrequency of the dressings, the absence of odor, and the fact that one is able from day to day to note the amount and character of the discharge. Patients may be allowed to go about without interrupting the process of aspiration.

When the discharge has fallen below ten cubic centimetres in twenty-four hours, the use of the tube may be discontinued, and in subacute or chronic cases where obliteration of the cavity has been comparatively slow, bismuth paste may be used with advantage.

In all cases of empyema the importance of fresh air and forced feeding should be emphasized. Even in cases where drainage is established early, and where rapid obliteration of the cavity occurs, there may be complete absence of healing for several days.

#### ILLUSTRATIVE CASES.

CASE I.—*Subacute empyema*. J., aged sixty-eight years, had a chill November 10, 1910, followed by symptoms of pneumonia at the right base. On the ninth day the temperature was  $100^{\circ}$ – $102.2^{\circ}$ . On the seventeenth day it reached  $103^{\circ}$ ; on the nineteenth day,  $103.2^{\circ}$ ; and by the twenty-fifth day it had assumed a septic type, oscillating between  $98.2^{\circ}$  and  $102.2^{\circ}$ . On the thirty-first day an exploratory puncture was negative. The temperature was  $98.3^{\circ}$ – $100^{\circ}$ . On the thirty-sixth day, December 17, a second puncture yielded pus. The patient was admitted to the hospital, and thoracotomy was performed on the same day. A large quantity of foetid pus was evacuated. Cultures showed a pure growth



of pneumococcus. From December 17 until January 4 the pus-soaked dressings were changed twice daily. On the latter date, when by the courtesy of Dr. J. Alex. Hutchison the case was transferred to my care, the discharge was still profuse, greenish yellow, and contained large clots like nummular sputum. There was no evidence of repair in the thoracotomy wound. Tidal air was demonstrated. The cavity measured 16 cm. vertically, 12 cm. transversely, and 6 cm. anteroposteriorly. January 4, a negative tension dressing was applied, and at the end of 24 hours there was a marked change in the character of the discharge. During the following 27 days there were seven dressings. For further particulars one should consult the accompanying pus chart.

### EMPYEMA (SUBACUTE).

Negative tension dressing applied January 4, 1911, 17 days after operation.

Date.	24 hours discharge c.c.	Character of discharge.	Remarks.
Jan. 5	58	Purulent	Slightly foetid.
Jan. 6	108	Sero-pur.	Continuous suction.
Jan. 7	55	Sero-pur.	Intermittent exhaust.
Jan. 8	Not est.	.....	Intermittent exhaust; 2d dressing.
Jan. 9	36	Sero-pur.	Intermittent exhaust.
Jan. 10	34	Sero-pur.	Intermittent exhaust.
Jan. 11	36	Sero-pur.	Intermittent exhaust.
Jan. 12	Not est.	Sero-pur.	Intermittent exhaust.
Jan. 13	35	Sero-pur.	Intermittent exhaust; 3d dressing.
Jan. 14	30	Sero-pur.	Intermittent exhaust.
Jan. 15	33	Sero-pur.	Intermittent exhaust.
Jan. 16	30	Sero-pur.	Intermittent exhaust.
Jan. 17	30	Sero-pur.	Intermittent exhaust; 4th dressing.
Jan. 18	13	Sero-pur.	Intermittent exhaust.
Jan. 19	13	Sero-pur.	Intermittent exhaust.
Jan. 20	15	Sero-pur.	Intermittent exhaust; 5th dressing.
Jan. 21	15	Sero-pur.	Intermittent exhaust.
Jan. 22	14	Sero-pur.	Intermittent exhaust.
Jan. 23	14	Sero-pur.	Intermittent exhaust.
Jan. 24	10	Serous	Intermittent exhaust; 6th dressing.
Jan. 25	10	Serous	Intermittent exhaust.
Jan. 26	8	Serous	Intermittent exhaust.
Jan. 27	10	Serous	Intermittent exhaust; 7th dressing.
Jan. 28	8	Serous	Intermittent exhaust.
Jan. 29	8	Serous	Intermittent exhaust.
Jan. 30	7	Serous	Intermittent exhaust.
Jan. 31	7	Serous	Intermittent exhaust; 8th dressing.
Feb. 1	4	Serous	Intermittent exhaust.
Feb. 2	2	Serous	Bismuth paste No. I, 3 c.c.
Feb. 6	.....	.....	Bismuth paste No. II, 2 c.c.
			No further discharge.

CASE II.—*Pyopneumothorax* (secondary to peripheral lung abscess). H., a girl, aged fifteen years. Illness began April 19, 1910, with a chill followed by symptoms of left-sided pneumonia. On the eighth day (April 26) the patient expectorated a large quantity of foetid pus, and the temperature fell from  $102.3^{\circ}$  to  $100^{\circ}$ . On the ninth day the highest temperature was  $101^{\circ}$ . On the tenth day, however, the temperature rose again to  $103^{\circ}$ , and subsequently the cough and dyspnoea became more urgent. When the patient was seen with Dr. Lafleur on the nineteenth day of the illness, the temperature was  $103.2^{\circ}$ , pulse 130, respirations 38. There was frequent cough with expectoration of purulent, blood-stained, foetid sputum. There was movable dulness in the axilla and left base. In the right lateral position the "coin sound" was heard in the anterior axillary line at the level of the fourth rib. The heart dulness occupied the midsternal position. Under local anaesthesia a rib resection and thoracotomy was performed at the level of the eighth rib in the midscapular line. A large quantity of thin, blood-stained, foetid pus was evacuated. The pressure mask was applied, and the deflection of the mediastinum was corrected, although there was no evidence of re-expansion in the collapsed portion of the lower lobe. Negative tension drainage was established. When the pressure mask was applied, the pulse was 140, and the patient was quite cyanosed. With the relief of pressure upon the mediastinum and healthy lung, the cyanosis promptly disappeared. At each subsequent dressing pressure was used while the tube was being changed. The large cavity resulting from the pyopneumothorax was entirely obliterated within three weeks by the compensatory expansion of the upper lobe, deflection of the mediastinum and sound lung toward the cavity, and upward retraction of the diaphragm. There was no evidence that the collapsed portion of the left lung had re-expanded.

Examination ten months after operation shows the area of cardiac dulness to extend from a line 1 cm. to the left of the left sternal border, 9 cm. towards the left axilla, with the apex beat in the sixth interspace in the anterior axillary line; that is to say, the mediastinum at this point touches the lateral plane of the body. The resonance and breath sounds are normal to the level of the fourth rib in front, in the apex of the axilla, and behind to the level of the eighth rib. In the lower axilla and

below the eighth rib behind there is dulness and complete absence of breath sounds, the costodiaphragmatic triangle having been obliterated by the upward retraction of the diaphragm. During deep inspiration there is retraction of the scar, which is evidently attached to the diaphragm. The skiagram shows the deflection of the mediastinum, as above described.

CASE III.—*Acute empyema*. T. H., a boy, aged seventeen years, developed left-sided pneumonia March 10, complicated on the fifth day by pericarditis. The temperature fell on the ninth

### EMPYEMA (ACUTE).

Negative tension drainage.

Date.	24 hours discharge c.c.	Character of discharge.	Remarks.
Mch. 21	560	Purulent	
Mch. 22	Not est.	Purulent	Intermittent exhaust; 2d dressing.
Mch. 23	625	Purulent	Intermittent exhaust; 3d dressing.
Mch. 24	620	Purulent	Intermittent exhaust.
Mch. 25	640	Purulent	Intermittent exhaust; 4th dressing.
Mch. 26	360	Sero-pur.	Intermittent exhaust.
Mch. 27	250	Sero-pur.	Intermittent exhaust.
Mch. 28	230	Sero-pur.	Intermittent exhaust.
Mch. 29	478	Sero-hemor- rhagic	Continuous suction.
Mch. 30	165	Serous	Intermittent exhaust; 5th dressing.
Mch. 31	60	Serous	Intermittent exhaust.
Apr. 1	65	Serous	Intermittent exhaust.
Apr. 2	55	Serous	Intermittent exhaust; 6th dressing. (Cavity obliterated.)
Apr. 3	20	Serous	Intermittent exhaust.
Apr. 4	15	Serous	Tube removed.

day by slow crisis to 99.2°. On the eleventh day there was a slight febrile reaction, the temperature rising to 99.6°, followed by profuse sweating, subnormal temperature, and severe toxic symptoms, of which delirium was the most prominent. A friction rub had made its appearance in the lower right axilla. Aspiration of the left thorax withdrew 2400 c.c. of thin pus. On the following day, March 21, the patient was seen by me at the request of Dr. G. G. Campbell, and, under local anæsthesia, resection of a portion of the sixth rib in the left posterior axillary line was performed; 540 c.c. of pus were evacuated. The cavity extended beyond the range of digital exploration. An air-tight negative tension dressing was applied without the occurrence of pneu-

mothorax. Apart from symptoms of bronchopneumonia in the right axillary zone, the patient made an uneventful recovery. On the twelfth day after operation the cavity was found to be entirely obliterated, although negative tension was maintained for two days longer with a short tube, to insure the complete obliteration of the drainage tract.

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# A STUDY OF CARCINOMA MASTITOIDES.\*

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IN examining the very extensive literature of mammary carcinoma, there is occasionally noted a rare and peculiar variety of this neoplasm, designated by various authorities as "mastitis carcinosa," "inflamed cancer," "acute brawny cancer," and other terms. A close analysis of these scattered cases has shown that the tumor described is the same in all of the reports, and that the general characteristics of this growth are, that it is a very rapid, fulminating variety of breast cancer, which by setting up violent irritation, produces a round-cell infiltration closely simulating a primary mastitis. It is to this group or variety that the writer has applied the term carcinoma mastitoides.

The condition appears to have been first described by Volkmann<sup>1</sup> in 1875, and was styled by him mastitis carcinosa. The other later writers have in general dismissed the subject without detail, calling such tumors inflamed or acute cancer. W. R. Williams<sup>2</sup> describes a rare form of cancer, in which the whole of one or both breasts may be simultaneously involved. It arises suddenly, progresses rapidly, and is often accompanied by inflammatory phenomena. No special tumor is formed, but the whole breast becomes enlarged and hard, the skin reddened, œdematous, and adherent, and the subcutaneous veins unduly visible. The adjacent lymph-glands are usually soon invaded, and there is general dissemination of the disease, with death from acute toxæmia, its total duration seldom exceeding a few months. Most cases, but not all, arise in connection with pregnancy and lactation.

The disease usually affects women in the first half of life, and is most frequently associated with late pregnancy or lacta-

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\* Read before the Philadelphia Academy of Surgery, March 6, 1911.

tion. It spreads with marked rapidity, gives rise to profound toxæmia and early metastasis, death appearing in less than a year from the onset in most of the reported cases.

The growth usually manifests itself as a general, painful, and rapid enlargement of the entire breast, without the presence of any previously noted mass or area of induration. The gland becomes reddened, hot, œdematous, and may present a sense of fluctuation. Appearing, as it most frequently does, shortly after parturition, the similarity to acute mastitis is marked, and many patients have been persistently treated on this basis. The skin shortly becomes infiltrated and brawny, and small areas of necrosis may appear. The nipple may or may not be retracted, and the axillary and supraclavicular glands are early enlarged in the majority of instances. The skin of the thorax immediately surrounding the breast may become indurated and reddened; there is usually some elevation of temperature, and locally the part is hot. A point of interest is, that though small abscesses are occasionally noted, in no case did the breast tissue break down *en masse*. Cachexia is profound and metastasis rapid, death transpiring from toxæmia.

*Diagnosis.*—The differentiation of this form of carcinoma from an acute purulent mastitis presents the greatest difficulty, and in many cases can only be definitely determined by the microscopic examination of an excised portion of tissue. In general it may be said, that temperature is not so high in carcinoma mastitoides as in mastitis; the skin is usually more brawny and adherent to the underlying tissues, while the early enlargement of the adjacent lymph chain is of no diagnostic value as it may readily appear in both diseases.

On incising such a tumor, there will be found a fairly firm tissue, which may or may not present small abscess cavities. The substance of the growth is usually firm and fibrous, of a purplish red color, and frequently exhibits small, isolated areas of hemorrhage. There are usually scattered throughout the gland small necrotic spots, sometimes abscesses of considerable size. The contiguous skin is markedly indu-

rated and cedematous, the induration extending, in the writer's case, beyond the middle line anteriorly and to the postaxillary line posteriorly.

*Prognosis.*—The prognosis is uniformly bad, this being one of the most rapidly fatal of all malignant growths. Billroth<sup>3</sup> reports a case in which death from toxæmia occurred within six weeks from the discovery of the tumors.

*Treatment.*—This should, of course, be radical extirpation of the breast and lymph-glands, immediately upon the diagnosis being made. In view of the relatively large number of these cases, it would seem wise to excise for microscopic examination a small portion of the breast in all doubtful cases of acute mastitis which do not yield promptly to antiphlogistic treatment. In the writer's case, the patient had been treated expectantly for three months with a diagnosis of mastitis. The case in detail was as follows:

M. L., thirty-three, married, was referred to me by Dr. R. D. Rhein, Aug. 27, 1910. The family history was irrelevant, and she had previously been a strong, healthy young woman. Five months before, she had been easily delivered of a normal, full-term child. One week after delivery she noticed a "lump" in the left breast, which was treated by the usual rubbings with oils, etc., but steadily increased in size and became hot, tender, reddened, and painful. At this time she had some fever, and the breast was incised without result. She had been seen by several physicians, all of whom confirmed the diagnosis, until she visited Dr. Rhein, who suspected some malignant change.

On examination the patient was found to be a well-nourished young woman, the mucous membranes somewhat pale, chest negative, temperature normal. The right breast was lactating, the abdomen was negative.

The left breast was enlarged to the size of a large grape fruit, was brawny in consistency, purplish red in color. The nipple was somewhat retracted, the skin of the "pig skin" type; the axillary glands appreciably enlarged, and the entire left side of the chest wall indurated and brawny. On palpation there was noticed considerable local heat and a distinct sense of fluctuation deep in the body of the gland. Interstitial mastitis with a deep,

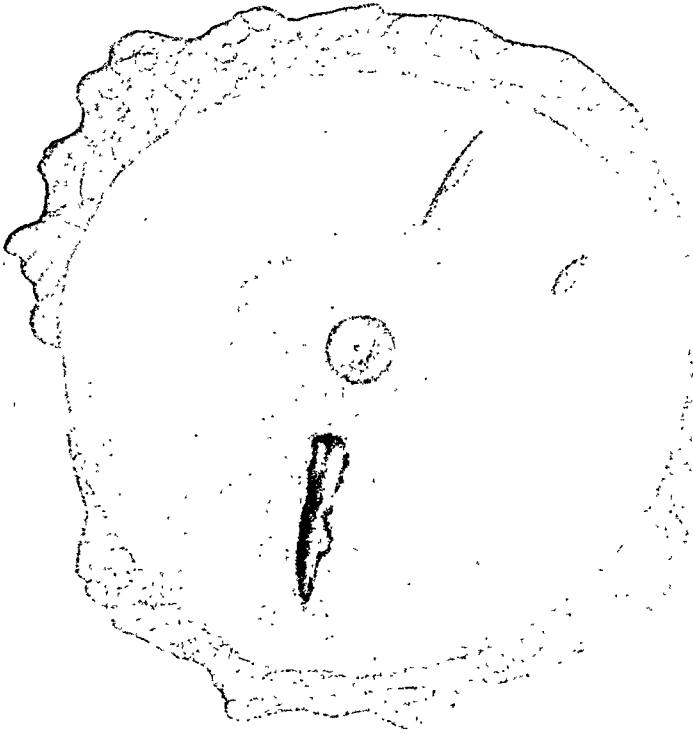


small abscess was diagnosed, and under light anæsthesia deep radial incisions were made, to the pectoral muscles. The breast tissue was found to be firm and tense, of a reddish gray color, with a few scattered, localized hemorrhagic areas, and several small abscesses. After a few days, the tissue began to break down *en masse*, with a profuse discharge of thick, foul pus. At the expiration of ten days it was found that, though the degenerative process had largely ceased, the breast was, if anything, larger than before and still tense. Accordingly, radical excision was decided upon and performed at the Gynæcean Hospital in the presence of several surgeons of prominence, none of whom cared to offer a definite opinion as to the nature of the growth. The enlarged axillary glands were removed together with the breast and the pectoral muscles.

Owing to the induration of the surrounding integument, there was a marked defect in the wound which required skin grafting. The incision healed slowly, and within a week many dark brown, shot-like nodules appeared along the line of the scar. These nodules broke down into shallow ulcers, which healed and were in turn followed by more hard nodules. In November, six weeks following the operation, the patient began to complain of headache, pains in the chest, and a mass in the right breast. She lost considerable flesh, and developed the complexion and weakness of profound cachexia. December 1, the right breast was excised, the mass in its outer lower quadrant having grown to the size of an orange and being somewhat tender on palpation. This breast was unfortunately destroyed by a misunderstanding of the nurse. The wound healed at once and gave no further trouble. December 15 the woman had grown much weaker and suddenly developed very rapid breathing with a left sided pleurisy. About 500 c.c. of clear serous fluid was withdrawn from the left pleural cavity, with some relief. Within a few days she developed a basal meningitis and died in coma December 20, just eight months after the first knowledge of any disease of the breast. Autopsy was refused.

*Pathological Examination.*—The specimen consists of the left mammary gland. The organ is hemispherical in shape, measures 12 x 12 cm., with a maximum thickness of 6 cm., is hard and indurated, and *in situ* was seated upon a zone of indurated subcutaneous connective tissue, extending from the sternum to the midaxillary line.

FIG. 1.



Carcinoma mastitoides, gross appearance. The diffuse nature of the tumor is shown, with the necrotic radial incisions.

badly infected, discharging pus freely and covered with sluggish granulations.

Our first efforts were directed to building up the boy's health and strength by general hygienic, dietetic, and tonic measures, and to get rid of as much of the infection as possible. All the milk and eggs he could take, raw beef juice, 12 oz. a day, plenty of fresh air, nux, quinine, and iron were the general measures used. Moist weak bichloride of mercury dressings were applied locally and changed daily. Under this treatment, he gained considerably in weight and strength, the hæmoglobin percentage rose, and the granulating surface became cleaner.

Deeming him too weak to stand autogenous grafting, grafts were taken from others. Seventeen attempts of this kind were made, the grafts being taken from fifteen different individuals. In every case the grafts did well at first and remained in seemingly good condition for about three weeks, when in the course of a few days they would disappear, leaving no trace. Both Thiersch and Wolf-Krause grafts were employed with equally complete failure.

As a last resort, under local anæsthesia, long, tongue-like flaps were cut wherever possible and turned into the burned area, being left attached to normal skin by a narrow pedicle. This procedure proved entirely successful and the epithelium rapidly covered in the areas between the flaps. Flaps were turned nine times; two flaps on three occasions, only one at other operations.

Of necessity the application of this method was limited and we now turned to small autogenous Thiersch grafts. The technic employed was as follows: Over a portion of the granulating area, the granulations were curetted away or trimmed down. Gauze moistened in 1 to 4000 adrenalin chloride solution was laid over the areas so treated. This controlled hemorrhage very satisfactorily. The area from which the grafts were to be taken was then prepared with ether and alcohol, and parallel lines of infiltration with 1:500 novocaine solution were made. Along these lines narrow strips of Thiersch grafts were taken. These strips were cut into small pieces. The denuded area was dressed with a thick layer of sterile vasoline spread on cotton flannel. Small pieces of the grafts were then applied

# MODIFIED AUTOGENOUS GRAFTING AND TURNING SKIN FLAPS TO COVER GRANULATING SURFACES.

REPORT OF EXTENSIVE BURN PRESENTING UNUSUAL FEATURES.

BY MARTIN B. TINKER, M.D.,

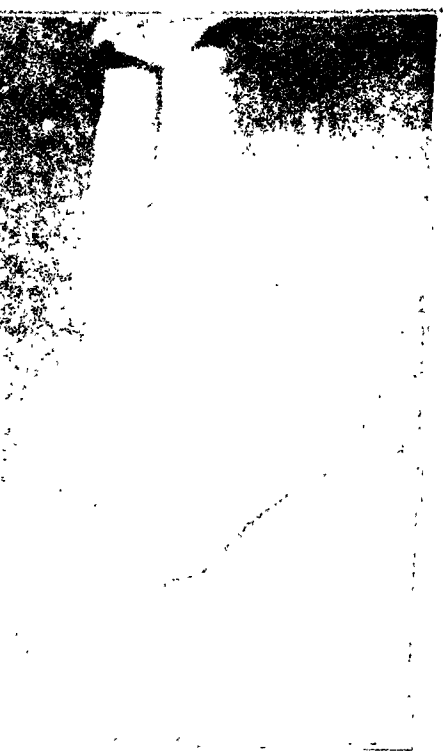
AND

HOWARD L. PRINCE, M.D.,

OF ITHACA, N. Y.

THE case reported below, while probably not unique, presented many uncommon features. The methods employed are also not strictly original, but differ considerably from the usual methods employed in such cases. The case is not the only one which has been treated by the methods described. It has been selected from 35 cases which have been under treatment for similar conditions during the past seven years, because it illustrates especially well the value of the modifications of usual methods described.

The patient, H. E., aged twelve years, threw gasoline on a bonfire in August, 1909. His clothing caught fire and he was badly burned over the areas marked in the photograph. With the exception of scattered spots on the buttocks and arms, the burns were of the second and third degree. In a hospital near his home, some weeks after the injury, large Thiersch grafts were taken from both thighs of the patient. These grafts failed to take, and he was left with large suppurating areas on the thighs in addition to the burned surfaces. At the same hospital, a like attempt was made with grafts taken from his father with the same result. The first of January, he was brought to the Ithaca City Hospital. At that time his condition seemed hopeless. He was very thin and anæmic; appetite and digestion poor; temperature ranging above normal; so weak that he had been confined to bed for over three months. The raw areas were



to the raw surfaces rendered dry by the adrenalin chloride solution. They were dressed with gauze wrung out of saline solution, over which was placed oiled silk. Because of the large amount of discharge from the granulating area, the gauze was moistened every four to six hours and changed every twenty-four hours. Later on when a rather severe infection with *Bacillus pyocyaneus* occurred, the gauze was moistened with a 1:10,000 bichloride without perceptibly influencing the grafts or the infection. Careful and thorough cleansing of the skin about the granulating surface seemed to be the most efficient means of controlling the infection, and its influence varied directly with the conscientiousness of the individual doing the cleansing.

The modified Thiersch grafts managed in this way were uniformly successful and the patient left the hospital entirely healed on December 24, 1910.

In April, 1911, we decided to try to approximate the extent of the area originally uncovered by skin. Of necessity it was an approximation. The area of the scar is considerably less than that of the original denuded area. Spaces between the flaps turned in, which were at that time 2 to  $2\frac{1}{2}$  inches wide, are now from  $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch wide. Any one with much experience in burn cases realizes the extent to which contraction takes place.

The scarred areas were divided into approximate parallelograms and triangles and the surfaces estimated in that way. The figures thus obtained were 3075 square centimetres (about 500 square inches).

The total skin area of the human body is variously estimated. Vacher gives 10,500 to 15,000 sq. cm.; Wilmart, 16,400 to 18,700; Lefevre, 14,500 to 15,000; Bordier, 16,717 to 19,445 for men 5 ft. 9 inches in height. Sappey, working with six average sized adult men, puts the figures at 15,000 sq. cm.; the average adult woman, 11,500 sq. cm. The boy in this case was twelve years old at the time of his accident, a little over 5 feet tall and weighed between 70 and 80 pounds. At the time he left the hospital in December, 1910, he weighed 98 pounds. Considering his size as related to that of the average adult male, it would seem that 9000 sq. cm. would be a high figure for his skin area.

With a scar measuring about 3075 sq. cm. it seems certain that in this case there was well over one-third of the body area denuded of skin at one time.

This case has seemed to us and many other physicians who followed the progress of the boy to be of unusual interest for many reasons.

The denuded surface was unusually large to be followed by recovery. The older text-books all estimate that a burn involving more than one-third of the body surface is almost sure to be fatal. The careful estimates given above show that this area was very much exceeded in this case.

A second point of great interest and value was the complete failure to get any results from heterogeneous grafts. In many cases of skin grafting, heterogeneous grafts taken from one person will fail, while those taken from another will "take" successfully. In this case, 17 attempts were made with heterogeneous grafts taken from 15 different persons and with ultimate failure in every instance. Of further interest in this connection is the fact that primarily every one of these attempts promised to be successful. Almost all of the grafts adhered well, and in most cases seemed to be spreading and covering in the raw surface nicely. The improvement would continue for about two and a half to three weeks. In several cases, the grafted surfaces seemed to be entirely and permanently covered in with the heterogeneous grafts and the epithelium which spread over the raw edges. But at the end of about three weeks, the grafts began to fade slowly and apparently dissolve away like ice in water, again leaving a raw surface. The results for the first two or three weeks were in every case encouraging. The disappearance of the grafted skin is probably caused by a process similar to hæmolysis. The grafts and epithelium disappeared in the same way that the blood-corpuscles disappear in many cases of blood transfusion. A further study of this condition would seem to be desirable and to promise much of scientific interest.





have recovered had general anæsthesia been given to him repeatedly for small operations, and he almost certainly would not have recovered had an attempt been made to cover the entire surface or any large portion of it by one operation at first.

There are undoubtedly many less serious cases of burn or injury in which a similar procedure would be advantageous. Very many patients come through a long and tedious convalescence, attended by much pain and considerable risk to life from septic poisoning, who could be promptly healed by this method of skin grafting under local anæsthesia with or without turning flaps as described. The conclusions given have been reached after a good deal of experience in handling 35 cases of this kind. The case described was selected as a text simply for the reason that the conditions illustrate especially well the difficulties usually met in such cases and a possible successful solution of the problem.

A third point demonstrated to our satisfaction in this and in a number of other cases is that it is unnecessary to scrape off the granulation tissue in preparing the surface for grafting. The granulations need be simply trimmed down a little with scissors curved on the flat. This gives very much less bleeding than entirely to scrape away the granulations as was tried on several occasions. The results were as good when the granulations were simply trimmed as when they were entirely scraped away.

A fourth point which has been mentioned by other observers is that the autogenous grafts do well in spite of infection. The attempts to get rid of infection in this case have been already mentioned.

A fifth point that we have not seen mentioned in this connection is the use of a gauze sponge saturated with diluted adrenalin chloride solution applied immediately to the freshened surfaces to arrest oozing. In this way a very considerable amount of blood was saved.

Sixth, we would again call attention to the fact that both the thin Thiersch grafts and the full thickness Wolf-Krause heterogeneous grafts were unsuccessful.

Seventh, an unusual feature deserving emphasis, it seems to us, was the turning in of flaps to cover the raw surfaces. The advantages of turning in flaps were several: (1) It did not create any further raw surfaces; (2) there was much less loss of blood than when a surface of any considerable size was grafted. Both of these points were matters of great importance in the case of a boy so weakened, anæmic, and septic. (3) Such flaps proved certain to grow if properly used. (4) Ultimate results were much better than if grafts alone had been employed. The peninsulas of normal skin formed by turning in flaps give less scar-tissue contraction, for these strips of normal skin soon become naturally elastic and also have normal sensation.

Of great importance seems to us the use of local anæsthesia. In this case it seems highly improbable that the boy could

forceps. This type of container has been widely accepted, and is a great step toward asepsis and economy of energy.

The defects in this type, as met with in the writer's observation of hospital work, are partly mechanical. The sliding bands become dented and jammed, the lid loosened, the single hinge bent, and the closure untrue. The holes are many, and closure of all holes is frequently not effectual; either the sliding band is defective or else the contents get jammed in a hole and become contaminated unobserved. Also machinery is needed to operate the lid, a lever, a foot pad, and counterweights. As the foot pedal requires a strained posture on the part of the nurse, it wastes time when the saving of an instant may be important. Also, if the unused contents are to be carried over to a succeeding operation, they must be handled only by sterile forceps, another waste of time and energy. Most important, the contents are subject to contact-infection from one case to the next through accidental use of unclean forceps and hands in stress of emergency, and many surgeons, realizing this danger, assign the most highly trained operating room nurse to attend the pedalling and doling out of the clean goods, thereby losing her from the operative field.

To preserve the advantages and to obviate the defects of the present metallic containers, the writer devised for the Roosevelt Hospital the new type of container now to be described. It has been tried out under adverse conditions, night emergency cases, and shifting nursing corps, etc., and has been found to meet every requirement.

The container as shown in the diagram (Fig. 1) consists of a longitudinally split copper shell, opening along the back on a strong rolling or piano hinge, into two equal halves, making when open a flat table, as it were. It closes by a single overlapping engaging joint, into a dust-proof cylinder of appropriate size to fit a sterilizer. For a 16 inch sterilizer it is  $14\frac{3}{4}$  inches in diameter over all, and is 18 inches long.

The shell is planned to carry an excess of all the operating supplies required at any operation, towels, all sizes of wipes, pads, dressings, cotton and bandages, glassware, safety pins

## A NEW CONTAINER FOR STERILIZED OPERATING SUPPLIES.

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OF NEW YORK.

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EVERY device that simplifies the handling of the operating room supplies is a step toward absolute asepsis as well as toward economy of energy. The new container here described is such a device, and since it is adapted to a single operation it has been called the "unit shell." It consists of a large longitudinally split cylinder assembling in one receptacle the dry goods needed for one operation, easily packed, and effectively sterilized and stored. It is simple, convenient, and time saving in the operating room.

The day of the many small package system in hospital practice passed when it became possible to sterilize large bundles by vacuum exhaustion and steam under pressure. This advance simplified the technic. Preparing and opening a few cloth- or paper-covered bundles was found quicker and safer than handling many.

The next step in advance was the use of a large drum-shaped metallic container. This drum was more economical of space in the sterilizer, less exposed to contamination during storage, and more readily accessible to the clean operating room attendant than any package hitherto devised. The best types were of copper, with holes in the side which were open during sterilization and closed immediately thereafter by a sliding band. These were designed to stand on a skeleton frame in the operating room with an arm to engage the lid and open the same when desired, by a foot pedal. Usually a full operating room equipment was contained in three or four drums. Into these the nurse plunged for supplies with sterile

FIG. 2 A.



Carcinoma mastitoides. At *A*, is shown the poorly defined nest of cells, invaded and surrounded by a dense round-cell infiltration, with much granular debris. At *B*, is shown one of the papillary growths, a tubule lined with a single layer of carcinoma cells.

and drainage tubes, rubber goods, etc., as experience dictates sufficient for any extensive operation—in fact, everything except dishes, instruments, suture material, and surgeon's attire. The routine of packing is indicated by written schedule, so as to properly apportion the amount of contents and to place them where they can be found conveniently. The goods of each half are enveloped in a thin muslin cover, which can be thrown back to drape the edge of the opened shell, are covered by a towel, and are held in place by a detachable wire mesh cover.

The shell is then partly closed and so clasped as to leave open a half-inch slit, and is subjected to the usual sterilization (Fig. 2). Steam penetration is very effectual, since an entire slit is open instead of a few small holes as in a drum, and the steam has direct access to the deep interior of the package. The exposed surface to steam and to drying in the unit shell is 504 square inches, against about 12 square inches in the old type of drum.

Immediately after the completion of sterilization and drying, the shell is taken out, the clasps are closed, sealing the contents, lock pins are inserted, and the shell is stored for use.

The advantages to be noted thus far are, a durable shell with few working parts not readily to be damaged by mishandling, a strong rolling hinge, and overlapping engaging joint ensuring accurate closure, also effective exposure to steaming and drying in the sterilizer, and a dust proof and locked closure of the single joint of the container during storage.

When to be used, the shell is placed on a stand by a non-sterile attendant, and opened flat, making a table 18 inches by 28 inches (Fig. 3). The two wire meshes are removed by a sterile attendant, the muslin covering thrown back, draping the sides of the table and exposing the towel covered contents, accessibly arranged. This entire procedure consumes only thirty seconds, and in addition to being a great economy of time and energy, eliminates possible oversight in laying out necessary supplies and the danger of contact-infection which

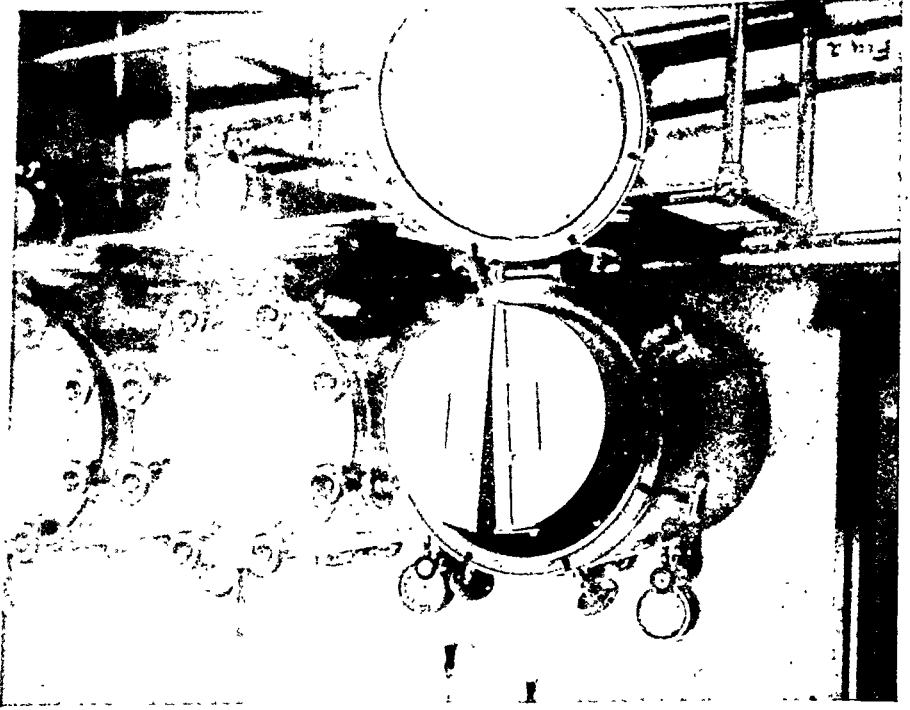


FIG. 2.

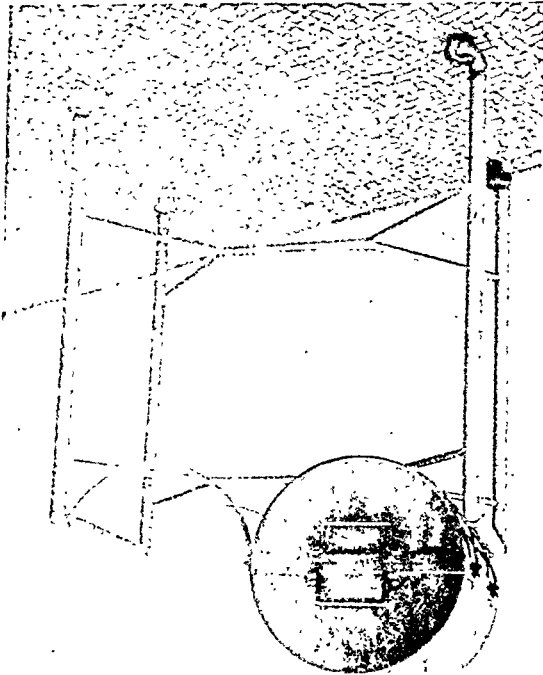


FIG. 1.

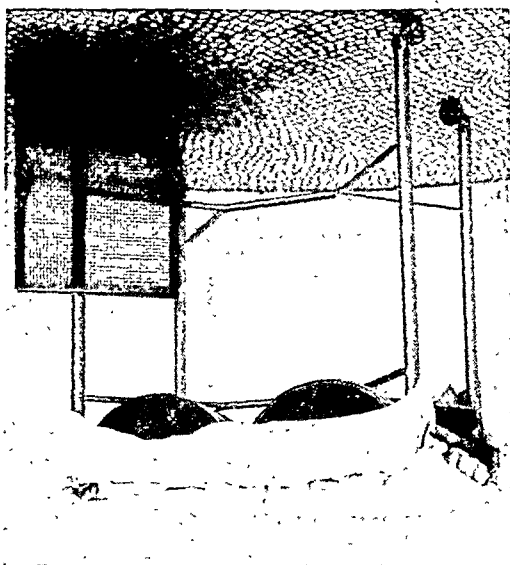


FIG. 4.

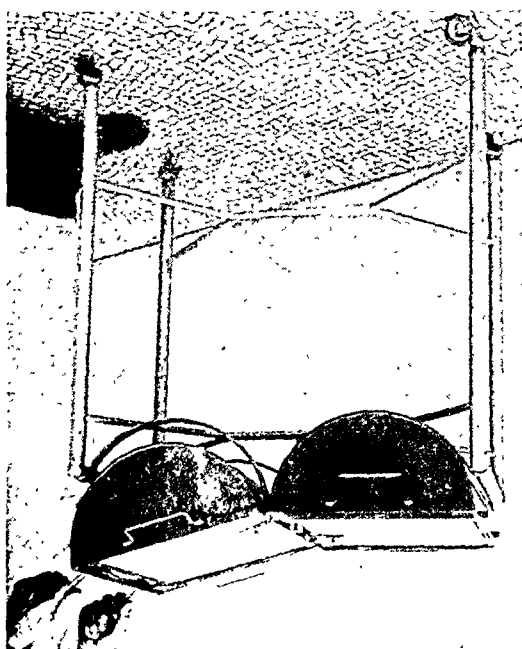


FIG. 3.



attends the opening of each package in the multiple package system. The most skilled nurse need not be assigned to handling supplies, as is the case with the present drum method, for none of the excess contents will be used on the next case and the goods are well protected against extraneous contact-infection.

Much waste motion of the drum system is saved by the use of the hand instead of the forceps, and by elimination of the pedal and machinery. This saving totals in the shell system five seconds on the average for each article secured, as over the drum method under like conditions. The goods are also accessible over a wider area, 504 square inches in the open shell against 308 inches in two opened drums of the same total capacity, thus rendering the individual objects more readily found in the shell system.

At the completion of the surgical operation the shell is closed and removed from the operating room and a fresh shell placed for the next operation. The used shell can be removed and a new clean equipment of goods opened and accessibly arranged for the next operation in less than one minute.

After removal from the operating room, the shell may be replenished from stock within a few minutes and is ready to be sterilized for future use.

While the capacity of the container is limited, the apparent inelasticity of the contents is minimized by experience in packing. An excess of those goods which may meet an unusual demand is packed as a routine. Nor does this excess mean any waste in material or in labor, for it remains in the shell and is merely added to in repacking. Rubber drainage tubes and such perishable goods are renewed when deteriorated, or about every tenth sterilization, providing they have lain unused so long. The remaining cotton goods are moved toward the top in repacking, so as to become browned by many resterilizations. Occasionally, however, goods will run short in some extensive operation and a new unit must be opened. This is as quickly done as opening a small package. Minor operations may be handled by packing each half of certain

shells as a separate unit, opening one side as required for each operation.

The advantage from a stand-point of asepsis of a fresh unit for each case is so apparent as to need no comment.

In conclusion the "unit shell" offers a mechanically strong, dust-proof container, more effectively exposed to steam and to drying than any metallic container hitherto devised. It is capacious, simple, and safe in handling, is time-saving in preparing for and during an operation, and ensures in the simplest and speediest manner a clean, new equipment for each succeeding case in the stress of a busy clinic.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY.

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*Stated Meeting, Held at the Hospital for Ruptured and Crippled, October 11, 1911.*

The President, DR. CHARLES L. GIBSON, in the Chair.

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### FRACTURE OF THE NECK OF THE FEMUR TREATED BY THE ABDUCTION METHOD.

DR. ROYAL WHITMAN presented several patients who had been treated by the abduction method for fracture of the neck of the femur. The cases illustrated the two types of fracture of early life: first, at the epiphyseal junction, which was most common during adolescence in weak and over-weighted subjects. The injury was often slight, and as the process of separation was frequently gradual, the patients, usually, were not brought for treatment until months later, then for supposed disease.

In recent cases the displacement might be reduced by abduction and inward rotation, but if the fragments were adherent, an open operation was required in order that they might be separated and replaced in normal position.

In the second class of cases the fracture was similar to that in the adult, and was caused by direct violence. In all of the cases a functional cure had been obtained.

Dr. Whitman also presented a woman, seventy-four years of age, who had been treated by the abduction method for intra-capsular fracture. The bone had united without appreciable deformity, as demonstrated by an X-ray picture. The patient was able to walk with ease, although a slight limp persisted. This type of fracture directly involved the joint in the injury, as well as in the process of repair, and although perfect function might be restored in favorable cases, it could hardly be expected in aged subjects.

Dr. Whitman said the abduction method was a means of

applying surgical principles, namely, reduction of deformity and fixation of the fragments—principles that had heretofore been disregarded in the treatment of this type of fracture.

#### THE OPERATIVE TREATMENT OF PARALYTIC CALCANEUS.

DR. WHITMAN showed a number of cases illustrating this condition. In deformity of this type, in which the resistance was lost by paralysis of the calf muscle, the foot atrophied, the gait was insecure, and the distortion was progressive.

The design of the treatment was to substitute the stability of bony contact for muscular tension. The astragalus, the centre of anteroposterior and lateral distortion, was removed through an external incision. The foot was then displaced backward so that the tibia was brought into direct contact with the navicular. If the peronei muscles were active, they were transplanted into the tendo Achillis. Cavus was then reduced, lateral deformity was prevented by the malleoli which clasped the foot at its base, dorsal flexion was prevented by contact of the tarsus and the tibia, and a useful foot, which would support weight without the aid of apparatus, was assured.

This same procedure, Dr. Whitman said, was of service in cases of complete paralysis, the so-called dangle foot, and might be substituted with advantage for arthrodesis. One case of this kind was shown, the operation having been performed on both feet. The patient walked well without support, and there had been a very appreciable restoration of muscular power, which had before been latent.

#### ARTHROPLASTY FOR BONY ANKYLOSIS.

DR. WHITMAN showed three of these cases. The first patient was a woman suffering from chronic polyarthritis of the atrophic type. The left elbow was exposed by a posterior cross incision, and the upper half of the olecranon was removed. The lower extremity of the humerus was removed in a curved line, with the convexity uppermost; the remainder of the olecranon was then hollowed out to a thin shell of cortical substance, and the head of the radius was cut away, leaving a wide interval between the opposing surfaces, over which fascia was sewn. The triceps tendon was then stitched with silk to the upper end of the olecranon.

A similar operation to this was performed on the second patient, a boy nine years of age, for ankylosis following scarlet fever. Both operations had been done within a few weeks, and

passive movement was to be deferred until a sufficient time had elapsed to permit repair of the denuded surfaces. It was thought that the wide interval between the bones would effectually prevent union.

The third case was one of ankylosis of the wrist with flexion deformity following infectious arthritis. In this instance a section representing the first row of carpal bones was removed, and the deformity corrected. This operation was done two weeks ago.

#### EPIPHYSEAL FRACTURE AT THE UPPER EXTREMITY OF THE HUMERUS.

DR. WHITMAN showed this case to illustrate a perfect functional cure of epiphyseal fracture and displacement of the upper extremity of the humerus. The patient was a boy, eighteen years old, who had been treated six years before. The treatment was an adaptation of the abduction method used so successfully for fracture at the hip-joint, the principle being to adjust the long fragment to the small and uncontrollable fragment. The displacement was first reduced by abduction and rotation of the humerus. The fragments were then held in apposition by fixing the arm in abduction, with sufficient forward inclination, by a shoulder plaster spica, either in right angular abduction or by elevating the arm to a nearly perpendicular attitude. The method was also of service in the treatment of other fractures in the vicinity of the joint.

#### THE SHOULDER PLASTER SPICA.

THIS was illustrated by a patient who had been treated by open operation for fracture at the elbow. It was very serviceable whenever it was necessary to hold the arm in an extended position because of lateral deformity at the elbow. The entire limb, to the extremity of the fingers, was inclosed in the plaster bandage, which included the shoulder and the thorax, holding the limb in an elevated position and thus preventing the congestion and œdema that the extended attitude induced when the arm was dependent.

#### THE TREATMENT OF DISEASE OF THE HIP-JOINT BY ARTHRODESIS.

THE patient was a woman who was admitted to the hospital for deformity and pain, which had persisted for more than a year. Her symptoms were caused, apparently, by an infectious arthritis. She had been previously treated for sciatica.

The joint was opened through an anterior incision and the upper third of the head of the femur was removed, together with a section of the upper part of the acetabulum, after the method suggested by Dr. Albee. The limb was then fixed in extension and abduction. According to Albee's diagram, the denuded surfaces were brought together by abduction, but if the joint was, as in this class of cases, fairly normal, no such contact was possible, and as in this instance, the interval must be filled by new bone formation to assure ankylosis.

#### BACKWARD DISLOCATION AT ELBOW.

THIS patient, a boy nine years old, had been treated for several weeks before admission to the hospital for supposed fracture. The joint was opened by a posterior incision and the dislocation was reduced. The operation was done three weeks ago, and perfect function was expected.

#### EXTREME TALIPES EQUINO VARUS.

THE patient, a boy, nineteen years of age, came under Dr. Whitman's observation six months ago for a deformity which had been caused in early childhood by a cut with an axe which had severed the dorsal flexors of the foot.

At the first operation, the varus had been overcome by wrenching, and the contraction of the toes by tenotomy of the flexor tendons. Three months later, the equinus was overcome by force and by division of the tendo Achillis. The correction had been aided by constant use of the foot, which had been fixed in plaster during the treatment, and the patient had lost but two days' work in the interval. He now wore an ordinary shoe and walked without a limp. The long disused muscles were rapidly recovering functional ability.

#### A METHOD OF CORRECTING FIXED SCOLIOSIS.

A number of patients were shown by Dr. Whitman to illustrate this method, which was devised by Dr. E. G. Abbott, of Portland, Me. In the treatment of other deformities it was generally recognized that correction and over-correction was the first essential, after which the improved position might be retained by increasing the muscular strength and control.

In this deformity the attempt had usually been made to train

the muscles with the aim of correcting or lessening the distortion, or to apply braces to prevent an increase of the deformity already present. Correction, forcible or otherwise, had been attempted while the spine was extended or even hyperextended. The essential difference of the Abbott method was to flex the spine in order to remove all tension before attempting to correct the lateral deformity and the rotation incidental to it.

The patient was placed upon the back in a narrow hammock in a rectangular frame of gas pipe, provided with an adjustable extension for increasing the forward flexion of the body. The trunk was then drawn laterally and twisted in the reverse direction of the curvature, and a plaster support was applied. Later, a large opening was made over the flattened side of the chest to permit expansion under the influence of forced inspiration. The treatment was repeated at intervals, until, if possible, over-correction was attained.

The immediate results in the cases under treatment encouraged the hope that this was a practicable method of overcoming deformity in this intractable class of cases.

#### FRACTURE OF THE HIP TREATED BY THE ABDUCTION METHOD.

DR JOHN B. WALKER presented a woman, twenty-six years old, who slipped and fell, fracturing the neck of the femur. On the following day a long side splint was applied without extension. With this she was confined in bed for twelve weeks. She left the hospital on crutches and was obliged to continue their use during the following eighteen months, for no union was present. Two years after the original accident she entered Bellevue Hospital. When standing with the aid of crutches the left lower extremity hung apparently helpless; the glutei and other muscles of this thigh were moderately atrophied. Measurements showed 6 cm. shortening, confirmed by a radiograph, which showed the great trochanter to be displaced far upward.

Treatment was at once begun by applying a Buck's extension with fifteen pounds weight in order to reduce the shortening if possible. The weights were very gradually increased up to forty-five pounds. At the end of six weeks the continuous traction had diminished the shortening to 3 cm. An operation was now performed to bring the separated fragments together and secure them in apposition.

FIG. 3 A.



FIG. 3 B.



A, Dr. McFarland's section of Rodman's case. Notice the absence of stroma.  
B, Dr. McFarland's case. The well-defined cell nests invaded by the infiltrate of leucocytes.



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An incision beginning 2 cm. below the left anterior superior spine was extended downward and backward to the posterior margin of the trochanter and then vertically down the thigh, the soft tissues were divided, the capsule exposed and divided, exposing the fracture which had occurred, roughly, transversely through the femoral neck, the proximal fragment consisting of the upper third of the femoral head. Considerable callus was removed, and the fractured surfaces were freshened by the rongeur. By traction and abduction the freshened fragments were brought together with great difficulty.

A steel drill was passed through the great trochanter, the neck, the head, and into the wall of the acetabulum, thus spiking the fragments firmly together. The wound was closed with a small rubber tissue drain. A plaster spica was applied from the lower border of the ribs to the toes.

The wound healed uneventfully; the patient was confined to bed for eight weeks. Four weeks later a Thomas hip splint was applied and she went about on crutches, discontinuing the splint at the end of one year. Five months after the operation, the drill, which was loose, was easily removed by small forceps.

Two years after the operation there is some motion at the hip. Less than 2 cm. of shortening exists. She walks without a cane, is free from pain, and is supporting herself by doing regular work.

#### THE OPERATIVE TREATMENT OF THE DEFORMITY OF POTT'S DISEASE.

DR. ROYAL WHITMAN read a paper with the above title, for which see page 841.

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## ORIGINAL MEMOIRS.

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### PARATHYROIDS AND THEIR SURGICAL RELATION TO GOITRE.\*

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AND

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DURING the past several years the parathyroids have been studied by various methods, and, although our definite knowledge of their physiologic function and pathologic importance is limited, to-day we are justified in saying that these little glands are concerned in the metabolism of the body, and, consequently, that disturbances of them are of serious interest to both the internist and the surgeon. But, what seems to be the natural course in matters medical, the parathyroids, once recognized, became the object of numerous hypotheses. Theories have been advanced and diseases attributed to these structures without having the support of scientific investigation. Erroneous deductions have been made from defective experimentation, histologic conditions overlooked, and the findings misinterpreted. Illogical conclusions have been based on the administration of therapeutic agents, as, for example, the failure of parathyroid extract to control the attacks of

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\*Read before the Southern Surgical and Gynecological Society, December 14, 1911.

The skin is of the "pig skin" variety, of a deep purplish red color, brawny, and thickened. The nipple is retracted and fixed; the areola deeply pigmented and corrugated. Three somewhat broken-down incisions extend from the nipple to the pectoral muscle.

On section, the central portion of the gland is filled with a yellowish necrotic slough. Underlying this is a dense, pink fibrous area, extending throughout the entire depth of the breast. It exudes no juice on section. Areas of fat and small abscess cavities are scattered throughout the tissue. The fascia covering the pectoralis major muscle is much thickened and indurated.

Microscopically, the growth is a somewhat complex one. It has in main the characteristics of a medullary carcinoma, growing with a small amount of connective-tissue stroma, and interspersed with groups of closely packed cell nests of the scirrhus type. In still other areas the field is typical of the carcinoma simplex. The whole picture corresponds closely with that of the latter neoplasm, as described by Rodman.<sup>4</sup> The groups of cells vary greatly in their arrangement, from the dense, almost opaque nest to the long tubule or papillary outgrowth lined with the carcinomatous elements. The important feature of this tumor, however, is the secondary inflammatory reaction evidently set up by its presence. Wherever there is any considerable group of the cancer cells, it is surrounded by dense round-cell infiltration, interspersed with areas of connective-tissue hyperplasia amounting in some fields almost to fibroma. The round cells are mostly of the lymphoid type, and everywhere invade the carcinoma, surrounding isolated cells and separating the various nests from one another by dense masses of cells, granular debris, and broken-down tissue with necrosis. Many small abscesses are scattered throughout the tumor.

Fox<sup>5</sup> in speaking of this specimen lays stress on the fact that the connective tissue is forming but is not at the stage where it could be classified as fibro-adenocarcinoma. He considers the round-cell infiltration secondary and invading the cancer tissue, there being well-marked cell division in the round-cell infiltrate while the cancer cells themselves show no evidence of mitosis. This point is further observed by Gross<sup>6</sup> *q.v.* In a study of the reported cases, this invasion of carcinoma by a round-cell infiltrate, which from its formation appears to have been produced as a result of some action of the cancer cells, is universally noted.

Dr. Joseph McFarland<sup>7</sup> has very kindly loaned the writer two specimens from his collection which are evidently of the variety in question. One of them, a student's slide from one of the German clinics, has no history attached, but the section

shows plainly a scirrhus carcinoma growing in well-defined nests, which are separated by thin connective-tissue trabeculae. Growing in and around the cells is a well-marked round-cell infiltration, which in other fields has entirely replaced the normal breast tissue. This is shown somewhat diagrammatically in Fig. 3 *B*. The second section (Fig. 3 *A*) is from Rodman's case, *q.v.* Here there is a medullary carcinoma, growing without stroma and surrounded and invaded by a dense collection of polymorphonuclear leucocytes. The carcinoma cells are crowded with leucocytes and granular debris.

In the analysis of this special variety of carcinoma, two features are of paramount interest—the pathogenesis and the diagnosis.

It has been seen that morphologically carcinoma mastitoides does not differ from certain forms of carcinoma simplex, and that the marked difference which does exist is due entirely to the interaction of the carcinoma and the profound inflammatory reaction produced by it. It follows, then, that this excessive reaction of these especial cancer cells upon the surrounding tissues—a reaction sufficiently marked to engender a general, diffuse, round-cell infiltrate and connective-tissue hyperplasia so profound as to frequently eventuate in breakdown and abscess formation—must be based either upon some peculiar toxin formed by the cells themselves, or upon a localized loss of resistance to tumor invasion, existent in the breast itself.

Inasmuch as these growths are almost always found in mammae either in early lactation or the last weeks of pregnancy, when the glands are functionally at the height of their activity, it would seem that this condition is the determining factor. The exact process can only be conclusively described when more complete knowledge of the chemistry, notably the toxin-forming power of carcinoma, is attained. It seems a logical deduction, however, that when the essential elements of the mammary gland are in full activity, fulfilling their excessive and occasional function—the secretion of milk—that they must be exceedingly vulnerable to the action of any foreign

toxin, as a result of which action the pronounced inflammatory response is a direct sequence. The diagnosis, as has been said, presents the greatest difficulty, and the only scientific procedure is to excise a small portion of tissue for microscopic examination in all cases of supposed acute mastitis that do not yield to treatment which should ordinarily effect a prompt reduction of the inflammation. The reported cases in brief are as follows:

CASE I (RODMAN<sup>8</sup>).—A woman of forty-five years, who noted a marked retraction of the nipple of the left breast. The entire breast then began to enlarge, the greatest enlargement being in the axillary quadrant, there being, however, no distinct tumor. The process was a diffused and not a discrete one. Three months later a diagnosis of mastitis was made by a prominent surgeon. The gland was vividly red and covered with an eczematous eruption, and, indeed, closely simulated mammary abscess. The axillary and supraclavicular glands were enlarged. The growth proved to be a medullary carcinoma with pockets of pus scattered throughout. Rodman adds in his discussion that many cases of carcinoma and sarcoma may develop in pregnant or lactating women, which, while of rapid growth, cannot be classified as acute cancer, as the inflammatory symptoms are wanting.

CASE II-III (BLOODGOOD<sup>9</sup>).—Two cases of medullary carcinoma, simulating mastitis, with abscess formation are reported. Both of these cases had been treated on a diagnosis of mastitis before being admitted to the clinic.

CASE IV (BILLROTH<sup>2</sup>).—A thin, pale woman aged thirty-six, the mother of seven children, was admitted to the hospital when near the full term of her eighth confinement, with both breasts larger than a child's head and firmly adherent to the overlying skin. The latter was tense, shiny, congested, and marbled by bluish veins. The breast gave no milk or colostrum; there were no obviously enlarged axillary glands. The history she gave was, that five weeks previously hardness set in at the periphery of both breasts, which rapidly spread, with increase of size. The patient died a week later, the total duration of the disease being six weeks. At necropsy, both mammary glands were found invaded by a softish, lobulated reddish growth, from which milky fluid exuded on section. Histological examination revealed epithelial cylinders and alveolar gland-like formations, such as are found in ordinary breast cancers, embedded in a fibrous stroma densely infiltrated with small round cells. Secondary nodules were disseminated in the thyroid, pericardium, etc., but not in the axillary glands.

CASE V (SHEILD<sup>10</sup>).—A woman, aged fifty-two, was admitted to St. George's Hospital. Six months previously the patient struck the right breast, since which she noticed a swelling which steadily increased in size. She lately had much sharp pain and has lost flesh and strength.



The right breast was greatly enlarged, the nipple deeply retracted, and the skin marked by the old scars of numerous sinuses, for she had suffered from frequent abscess of the gland. The skin generally was of a deep congested blue color, but over the axillary part of the swelling it was red and gave the appearance of inflammation. There was considerable local heat, and the axillary glands were not enlarged. The inner part of the right breast contained a hard mass. It was quite uncertain as to whether or not fluctuation existed. Mr. Peck made an exploratory incision, which revealed undoubted cancer. This was hemorrhagic, being infiltrated with blood and breaking down superficially. The whole breast was thereupon removed.

CASE VI (SHEILD).—A healthy looking woman of fifty. The right breast was generally enlarged, skin dusky and red with increase of local heat, nipple retracted and adherent. Exploratory incision with the idea that it was an abscess revealed general carcinoma. The breast was removed, with death following some time after from recurrence.

CASE VII (MORRANT BAKER<sup>21</sup>).—The patient was a lady of thirty-four who had been confined four months before, and who was still nursing her infant. The right breast became large, hot, tense, elastic and painful, and the skin over it was ruddy and œdematous, as if occupied by inflammatory exudation. The surgeon believed that an abscess was forming and had the breast poulticed, and it was not until six months later that the real nature of the case was declared by the appearance of numerous cancerous nodules in the skin and the rapid enlargement of the axillary glands. The mistake here arose because all the circumstances of the case suggested the probability that the breast was the seat of an abscess, and secondly, owing to the youth of the patient and the vascularity of the breast in that patient, the malignant growth was very active and attended with great vascular disturbance, leading to redness, œdema, and heat of the skin.

CASE VIII (BRYANT<sup>22</sup> reports three cases).

A healthy looking single woman of forty-three, with acute disease of her right breast of two months' duration. The whole gland was infiltrated and the skin over it like brawn. The nipple was depressed and lost in the surrounding elevation of the breast. The axillary and supraclavicular glands were enlarged. This patient died in less than three months.

CASE IX (BRYANT).—A married woman of fifty-three, who had borne 11 children, was seen June, 1857. She had an acute brawny infiltration of her right breast and the skin over it, with œdema of the right arm. She had been perfectly well until three months before, when she noticed a swelling in the breast, which rapidly increased and became complicated with pain down the right arm. When seen, the axillary and supraclavicular glands were much enlarged, the breast was like brawn, the skin over it œdematous, and evidently infiltrated with new elements. Death occurred in three months from toxæmia.

CASE X (BRYANT).—A woman of forty-nine who had had six children presented herself with an enormously swollen, œdematous, and

indurated left breast of eight weeks' standing. There was severe pain in the part, which was worse at night, and there was at times increase of heat in the gland. The axillary glands were not involved. The integument over the breast was œdematous and pitted on pressure. In three months the axillary glands became involved, and skin over the breast became tense, reddened, and indurated. Death occurred in nine months, with a development of a similar growth in the right breast.

CASE XI (GROSS<sup>6</sup>).—A sterile, married woman of thirty-nine had a tumor which had acquired the volume of an egg in less than two months and contained an abscess as large as a filbert, filled with greenish pus. The abscess formed at the expense of the infiltrated connective tissue, the epithelial cells themselves not participating in the morbid process.

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## EPIGASTRIC HERNIA.\*

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AN epigastric hernia is that form of ventral hernia which is situated in the anterior abdominal wall, above the umbilicus, and in or near the linea alba, linea semilunaris, or in one of the lineæ transversæ of the rectus. Such a hernia may be due to a congenital or an acquired defect in the fibrous structures of the anterior wall of the abdomen, and is generally small in size and single. Exceptionally, however, they may be multiple and of considerable size, as in the case herein reported.

These small hernias were described as long ago as 1285 by Arnould de Villeneuve, in France, and in 1743, Garangeot recognized them as a possible cause of certain obscure abdominal symptoms.

Not until the latter part of the last century, however, was much attention paid to the lesion, for not until 1880 did Lucas Champonniere do the first deliberate operation for the cure of non-strangulated inguinal hernia, and Terrier, five years later, operate first for the cure of epigastric hernia. Terrier's publication of his first operated case, and his later paper insisting upon the intimate relation between these hernias and various painful abdominal conditions, did much to call attention to the subject and place the treatment upon a rational basis.

Though epigastric hernia is relatively rare, it is by no means uncommon, and possesses a literature which is quite extensive. According to the tables of Berger, based upon

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\*Read at a meeting of the New York Clinical Society, January 28, 1910.

an examination of 10,000 cases of hernia found at autopsy, only 116 of these, or a little over 1 per cent., were of the epigastric variety, and of these 105 were in males. This proportion of a little more than 1 per cent. may be accepted, perhaps, as a fair estimate of the relative frequency of the lesion, though the great disproportion in favor of males is not found in other smaller series of cases. Many of the subjects of epigastric hernia seen in the hospital come from the laboring classes, and lean muscular males subject to severe muscular strain furnish a fair quota of the cases. Sometimes, however, it occurs in flabby and obese women, and in emaciated, anæmic, and debilitated persons of both sexes.

*Causation.*—Many theories of its production have been put forward. Witzel thinks, that given a defect in the deep fascia of the anterior abdominal wall, the subperitoneal areolar tissue may be forced through it by means of increased intra-abdominal pressure, and drag with it, later, perhaps, a portion of underlying peritoneum so as to form a hernial sac.

Roser, on the other hand, thinks that the subperitoneal fat penetrates between the meshes of the linea alba, etc., and along the course of the vessels and nerves, often without the formation of a hernial sac; or in some cases the constant dragging upon this lipoma may result in sac formation and the appearance of a true hernia.

Terrier, in similar fashion, divides these hernias into four groups: (1) lipoma, or simple fat protrusion; (2) lipoma, with a peritoneal sac; (3) true epiplocele, without lipoma; (4) hernia, with omental and intestinal contents.

Heredity and the coexistence of other hernias may be of some etiological importance, but increased intra-abdominal tension, with a diminished resistance of the fibrous orifices in the anterior abdominal wall, plays the most important rôle in their production. Thus it may occur in the laborer, subject to violent muscular strains and trauma, or it may be found in the obese, with relaxed and flabby tissues and a chronic bronchitis. Hence the opposite types in lean muscular males and in fat flabby females.

*Symptoms.*—These consist in the presence of a tumor in the epigastrium (which may be so small as to be overlooked by both patient and physician, and only to be discovered by a careful examination of the patient in a standing position), and certain other abdominal symptoms which vary in different cases. Thus, indigestion, colic occasionally, constipation, and vomiting are complained of. Vomiting after meals, worse when standing, and relieved by lying upon the back and by reduction of the hernia. Neurasthenia, depression, and a train of curious nervous symptoms may sometimes supervene and lead to a condition which is pitiable in the extreme and due primarily at least to a small epigastric hernia.<sup>1</sup> The relation of these various symptoms, gastric and nervous, to what seems such an insignificant lesion has been clearly established, and the prompt subsidence after operation is striking and convincing as to the proper line of treatment to be adopted.

*Diagnosis.*—In true epigastric hernia this is not usually difficult, since gastric symptoms are present in full 80 per cent. of the cases, and this alone should help to differentiate the condition from one of subperitoneal lipoma or other tumor, although it is sometimes impossible to tell before operation the true from the false hernia.

The contents of the hernial sac vary widely. In some omentum alone, free or adherent, may be present, but in the larger ones, portions of stomach or a loop of small or large intestine may be found.

Sometimes these hernias are multiple protrusions through little holes at various points in the deep abdominal fascia, and some of these protrusions are true hernias and some are merely lipomata of the subperitoneal fat. Protrusion of the omentum alone into the sac of one of the smaller hernias, however, may give rise to severe and persistent abdominal pain, and gastric disturbances may result as surely from traction on the omentum in one of these small ruptures as in the

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<sup>1</sup> R. Lemièrè: Thèse de Paris, 1905, Dyspepsie et Hernie Epigastrique.

larger ones which are much less common but much less likely to be concealed. Strangulation in epigastric hernia is exceedingly rare, and the writer has been able to find the records of but two cases; one in which the small intestine was involved and another in which a portion of the wall of the stomach was involved. Both of these are reported by Massinger, and so far I have found records of no others. The report of the following case is offered as a contribution to the study of this very rare complication in an epigastric hernia.

CASE I.—Patient, a male, aged sixty-three, was admitted to Roosevelt Hospital February 15, 1909, with the following history:

He had been ill for three days with severe abdominal pain and vomiting, and distention of the abdomen had lately developed. His bowels were reported to have responded slightly to enemata, but it could not be discovered on close questioning, that gas had ever passed since the beginning of his seizure. As he was a very alcoholic individual and had suffered before from attacks of alcoholic gastritis which resembled this one, until the distention and fecal vomiting appeared, no serious consideration of the possibility of acute intestinal obstruction was entertained by his physician. The fact that there was any connection between a rather large sized epigastric hernia and his serious condition was not at first clear, but as the symptoms became more marked, a diagnosis of intestinal obstruction was made and he was sent to the hospital for operation.

On admission, examination showed a short, stocky, rather corpulent man, very drunk, nearly pulseless, and vomiting fecal looking material frequently. He walked into his room from the carriage and did not at all appreciate his serious condition, which, however, was most evident on examination. His pulse was very small and feeble and rapid, his abdomen distended and tender, and there was a good sized epigastric hernia in the middle line extending to both sides of the same for a considerable distance. This hernia was tender, irreducible, and was recognized as strangulated, and the patient prepared for immediate operation.

The operation, which was done under ether anæsthesia, had to be rapidly performed on account of the patient's very serious

condition, and an infusion of normal saline solution was run into his veins during its performance. He left the operating table in as good condition as when brought to it, but this was very bad.

*Operation.*—A long median incision was made above the umbilicus immediately over the hernia, and the pathology was quickly revealed. It was seen that the hernial openings were multiple, three in number, one large and two small. The principal opening was in the middle line, and there was one small opening directly above it, and another in the left linea semilunaris. Protrusion of adherent omentum was demonstrated in all the openings, and this was returned. In the principal and largest opening, in addition to a bunch of adherent omentum, there was a loop of small gut tightly strangulated and gangrenous. Immediate resection and end-to-end anastomosis by suture was rapidly done, and the wound closed. The patient was put back to bed and rallied fairly well, regaining consciousness and complaining of pain for which a hypodermic of morphine was given. This quieted him and he had been sleeping for some time when suddenly he began to do very badly, his respiration then his pulse giving out, and he died in spite of prompt measures to save him.

In a reasonably extensive operative experience the writer has never encountered a strangulated hernia of this variety, and in fact has had only two cases of strangulated ventral hernia besides this in his whole series of cases.

It is fair to say that this patient had been seen by the writer a year before his last illness, when he presented himself at the office for advice as to a right inguinal hernia and an epigastric hernia of considerable size, which was growing larger and beginning to cause pain. This hernia, however, was easily reducible. In view of the fact that the patient was a saloon keeper, a hard drinker, and not a good surgical risk, he was referred back to his physician for a report on his urine and never appeared again until his admission to the hospital in a practically moribund condition from strangulation of the epigastric hernia. His age, history, and general condition led me to be conservative about advising operation on his first visit, but there was no other recourse than operation when he finally appeared for treatment.

# THE PATHOLOGY AND SYMPTOMATOLOGY OF GALL-STONES.

BASED UPON AN EXAMINATION OF OVER 400 CASES OCCURRING AT THE  
LONDON HOSPITAL.

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THIS paper is based upon a careful review of the 409 cases of gall-stones occurring at the London Hospital during the ten years 1901-1910 inclusive, so that evidence either in support of or contrary to modern views on this subject might be gained. Only those cases are included where the diagnosis was proved by operative treatment.

## VARIETIES OF GALL-STONES.

Gall-stones may be of many different varieties and may be multiple or single. It is, however, almost constant to find all the stones, within the gall-bladder in any one case, of the same type, although in some cases one stone may have been displaced from the gall-bladder and then have undergone secondary changes, so that it comes to differ, in its outer layers at least, from the remaining stones. Bland Sutton<sup>10</sup> explains this similarity of the calculi on the supposition that they are all of the same age and formed by the same factors.

Gall-stones have many times been classified according to their constituents, the best known classification being that of Naunyn,<sup>78</sup> who divided them into six varieties. I have carefully examined and analyzed the stones from a large number of cases, and find that most of the accepted classifications will not agree with the conditions found. The following classification is simple, and all forms of biliary calculi will be found to fit into one or other of the groups.



I. *Cholesterin Calculi.*

(a) *Pure cholesterin* (Plate I, Fig. I). These are oval or rounded in shape, light yellow in color, semitransparent, and of a wax-like consistency, so that they are readily cut or indented with the finger-nail. The cut surface is homogeneous, or may be slightly crystalline. The external surface is finely nodular, and since these calculi are always single they are not faceted. They are nearly always small, but may be as large as  $1\frac{1}{2}$  inches in their long diameter. Most commonly they are found impacted in the cystic duct.

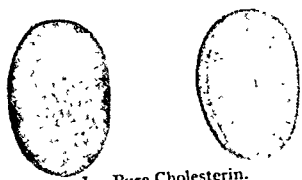
(b) *Cholesterin with Bile Pigment* (Plate I, Fig. II). These are somewhat similar to the above, but the cholesterin is mixed throughout with a certain amount of pigment, usually biliverdin, so that a waxy, pale green, semitransparent calculus results. Otherwise the characters are identical with those of the pure cholesterin variety.

(c) *Cholesterin with Bile Pigment and Calcium* (Plate I, Fig. III).—These stones, although mainly consisting of cholesterin and pigment, show chemically the presence of calcium, but it is possible that the calcium is mainly present in the form of bilirubin calcium, although some is undoubtedly in the form of calcium carbonate.

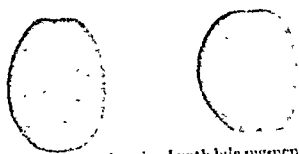
The calculi are usually about  $\frac{1}{2}$  inch in diameter, roughly nodular on the surface, but may show several smoothly polished facets where they have been in contact with other calculi, this factor depending upon whether they are single or multiple. They are hard, but if the amount of cholesterin be large may be easily cut or indented. More commonly they are gritty when cut with a knife. They are dull red brown in color, owing to the presence of bilirubin calcium. The cut surface is homogeneous or may be finely crystalline.

(d) *Crystalline Cholesterin with an Outer Layer of Bilirubin Calcium* (Plate I, Fig. IV).—These are rounded or roughly cuboidal calculi, varying in size from a small pea to a cherry stone. They are usually multiple, but rarely are more than three or four present. They are dark brown in color and smooth on the surface. On section the central portion

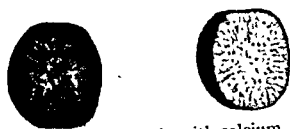
# CHOLESTERIN



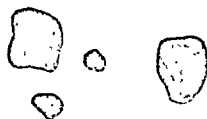
I. Pure Cholesterin.



II. Cholesterin mixed with bile pigment.



III. Cholesterin with calcium carbonate and pigment.



IV. Crystalline cholesterin with outer layer of bilirubin calcium.

## PIGMENT.



V. Pure biliverdin calcium.



VI. Biliverdin with outer layer of cholesterin.



VII. Pure bilirubin calcium.



VIII. Bilirubin with outer layer of cholesterin.

## MIXED—Laminated.



IX. Alternate layers of bilirubin calcium and cholesterin.



X. Alternate layers of biliverdin calcium and cholesterin



XI. Large single non facitted laminated calculus. This had ulcerated through into the intestine and caused obstruction

## MULTIPLE FACETTED CALCULI.



is found to be formed of radiating crystals of cholesterin covered with well-marked outer layer of bilirubin calcium. When fresh this latter material may be soft and form several layers which can easily be flaked off. When dry it becomes much firmer and more compact.

## II. *Pigment Calculi.*

(a) *Pure Biliverdin Calcium* (Plate I, Fig. V).—These form small friable calculi of a dark green color. They are very irregular on the surface, and may show many facets with an almost metallic lustre, looking not unlike small cinders. In some cases they may be somewhat larger, up to  $\frac{1}{2}$  inch in their longest diameter, and smoother on the surface. When dry they become extremely friable and tend to break up into dust-like particles.

(b) *Biliverdin Cholesterin* (Plate I, Fig. VI).—These calculi are found only in the gall-bladder. They are roughly nodular on the surface and of a yellow brown color. In their longest diameter they rarely exceed  $\frac{1}{2}$  inch in length. On section the centre is found to be formed of a calculus of the preceding variety, which has become coated over with a homogeneous layer of cholesterin containing perhaps a small amount of pigment.

(c) *Pure Bilirubin Calcium* (Plate I, Fig. VII).—These calculi, which, like the pure biliverdin calcium, may be found in the hepatic ducts, are formed of a dark brown material which may appear as small particles of grit or in larger masses to form a definite calculus. When fresh they are soft and friable, forming a putty-like material; when dry they become harder and show as irregular calculi often with metallic-like particles imbedded in them.

(d) *Bilirubin Cholesterin* (Plate I, Fig. VIII).—Like the biliverdin cholesterin, these calculi are found in the gall-bladder. They are generally smooth on the surface, and may be so lightly colored as to closely resemble pearls. In other cases the cholesterin may be pigmented with bilirubin. On section a centre of bilirubin calcium is seen, surrounded by a layer of cholesterin.

III. *Mixed Calculi.*

These are usually described as common gall-stones. They are extremely variable in shape, size, and number, and may be green or yellow-brown in color, according to the variety of pigment present.

If single (Plate I, Fig. XI), they are roughly nodular or even spiculated on the surface. In many these nodules correspond to depressions on the surface of the mucous membrane of the gall-bladder, and are evidently formed by the calculus being closely gripped by the gall-bladder. When fresh the surface layers are friable and are very readily flaked off, but on drying they become much finer and more compact. They are always very light in weight, owing to the amount of cholesterin present. They are very variable in size. Small ones may be only a quarter of an inch in diameter, but they may be found two or, in exceptional cases, three or more inches in their long diameter. If single the stones are roughly oval and show no facets. Those calculi which have passed into the intestine and have caused acute intestinal obstruction are usually of this nature.

If multiple, the stones are always faceted. If only a few are present each may form a section of a cylinder, the ends being faceted to accurately articulate with the stones on either side. In some cases a whole column of calculi may thus be formed to fill an elongated gall-bladder, the individual stones in some cases being one inch or more in diameter. The surfaces not in contact are then roughly nodular as in the case of a single calculus, whilst the faceted surfaces are smooth and often beautifully polished. In other cases the calculi may be present in very large numbers, when they are correspondingly smaller and each calculus may show a large number of facets. At times a very large number, several hundreds, may be articulated together to form a mosaic work completely filling the gall-bladder. The presence of facets is of value to the surgeon in showing that more than one calculus must recently have been present.

Some of these calculi are yellow-brown (Plate I, Fig. IX),



others green on the surface (Plate I, Fig. X), according to whether bilirubin or biliverdin is the pigment present.

On section the most characteristic feature of these calculi is that they are beautifully laminated. In the centre an area of friable pigmented material is seen surrounded by a layer of crystalline cholesterin, the crystals having a radiating arrangement. Outside this is a layer of biliverdin or bilirubin calcium, often mixed with a certain proportion of calcium carbonate. These layers are repeated, the number of layers depending upon the size of the calculus. The pigment layers may be either biliverdin or bilirubin calcium, or more rarely both pigments may be present in different layers.

#### IV. *Calcium Carbonate.*

Many of the calculi previously described contain a certain amount of calcium carbonate. Very rarely this substance may exist practically in the pure state as a biliary calculus. Among all the cases of this series there is no note of this condition having ever been present. There are specimens in the Middlesex Hospital Museum which are figured by Bland Sutton.<sup>10</sup>

Such calculi would give a well-marked shadow in a radiograph, for it is upon the presence of calcium carbonate that a radiographic shadow, in the case of gall-stones, depends.

#### *Pathology.*

Much work experimental and otherwise has been done to throw light upon the factors entering into the causation of gall-stones. Up to the middle of the nineteenth century the views of Galen put forward in the second century were held, *i.e.*, that the gall-stones were formed by coagulation of the bile. Frerichs<sup>32</sup> taught that in stagnating bile the bile salts underwent decomposition, the reaction of the bile became acid, and the cholesterin which was held in solution thereby became precipitated. That stagnation of the bile is a strong predisposing factor seems to be beyond doubt. As Hunter<sup>45</sup> says, "Stagnation of the bile is an etiological factor about which

there is no dispute." Mere stagnation is, however, insufficient to give rise to a calculus. Since cholesterin, which is the most common constituent of gall-stones, is normally present in the bile in a proportion varying from 0.045 to 1.18 per cent., it is at first sight natural to suppose that this material is simply precipitated from the bile and so gives rise to a calculus. The classical work of Naunyn<sup>78</sup> made clear, however, the fact that this cholesterin is not derived from the bile itself, but from the epithelium of the gall-bladder, and thus it is, as will be described later, that gall-stones formed in the hepatic ducts never contain cholesterin. He also showed clearly that the formation of calculi is dependent upon an inflammation of the gall-bladder, for under such conditions the amount of cholesterin is greatly increased, and the epithelial cells shed by the inflammatory change may act as a nucleus. The microbic origin of calculi seems to have been first suggested by Galippe,<sup>35</sup> who found bacteria in biliary calculi. He seems, however, to have laid but little stress upon the inflammatory changes caused by them in the gall-bladder, but rather to have looked upon their action as being that of forming a nucleus. The close relationship of gall-stone formation to bacillary infection was more carefully worked out by Welch,<sup>108</sup> who demonstrated the presence of *Bacillus coli* and *Staphylococcus pyogenes* in the stones and in the gall-bladder. Hanot and Létienne<sup>41</sup> found that in similar circumstances typhoid bacilli might be present, whilst Dominici<sup>37</sup> and Gilbert and Fournier<sup>38</sup> found the *Bacillus coli* present in 23 out of 70 cases examined. The latter also showed by experimental work upon animals that both the *Bacillus coli* and *Bacillus typhosus* were able to set up a cholecystitis which was followed by the formation of stones. Mignot<sup>70</sup> showed that gall-stones were only formed if the infection was chronic and attenuated. If the organisms were virulent an acute cholecystitis was set up but no gall-stones were formed. The nature of the organisms did not seem to be of great importance provided they were attenuated, for he showed that *Bacillus coli*, *B. typhosus*, *Staphylococci*, *Strep-*



*tococci*, and even *B. subtilis* were capable of giving rise to calculi. In acute infections the mucosa instead of being stimulated to excessive formation of cholesterin is probably destroyed outright.

The close relationship between microbic infection and the formation of gall-stones has been strongly supported by more recent investigators. Thus Deaver<sup>23</sup> found that of 94 cases in which cultures were taken *B. coli* was present in 25, *B. typhosus* in 13, *Staphylococci* in 5, *B. coli* and *staphylococcus* in 2, and unidentified organisms in 3. Funke,<sup>33</sup> however, examined 102 calculi and found that only 31 gave rise to a growth in bouillon. He believes from this fact that the first essential to the growth of calculi is impediment to the flow of bile, and that when this becomes stagnant infection usually follows. Although there is no doubt that stagnation will aid infection, and in this way probably acts as the predisposing factor, yet as Miyaki<sup>71</sup> has shown by experimental work, the most common sequence of events was firstly an infection, followed by catarrhal and desquamative inflammation, then the formation of a calculus, the presence of which led to a persistent chronic cholecystitis. In this present series of cases, 48 were bacteriologically examined; 10 were sterile. Of the others *B. coli* was present in 22, *Staphylococci* in 5, *typhoid* in 2, *B. coli* and *Streptococci* in 4, *Pneumococci* in 3, and *Streptococci* and *B. pyocyaneus* in 1 case each,—figures which are in close agreement with those of Hartmann,<sup>42</sup> who in 46 cases found 10 sterile, *B. coli* in 23, *Staphylococci* in 4, *Streptococci* in 2, *B. coli* and *Staphylococci* in 2, and *Streptococci* and other organisms in 3 cases.

The relationship between typhoid fever and gall-stones has been even more clearly shown. Bernheim<sup>9</sup> first laid stress upon this, whilst Chiari<sup>19</sup> demonstrated the *B. typhosus* in the gall-bladder in 19 out of 22 cases of typhoid fever. Richardson<sup>89</sup> has also shown the very close relationship existing between typhoid fever, cholecystitis, and cholelithiasis, while Cushing<sup>21</sup> found that of his series of cases operated on for gall-stones 30 per cent. had previously suffered with

typhoid. In this series of cases the connection was not nearly so marked. Thus of the 48 cases examined, only 2 showed the presence of typhoid bacilli, while only 20 patients had a definite history of previous typhoid fever, although in hospital patients such previous history is notably unreliable. It is of interest from this point of view that both the cases in whom typhoid bacilli were found did not give a history of previous typhoid and thus it is possible that many cases, although never showing symptoms of typhoid fever, are in reality infected and act as typhoid carriers, as described by Ledingham,<sup>53</sup> although Dudgeon,<sup>25</sup> in agreement with the above figures, was only able to isolate the *Bacillus typhosus* from the bile once in 20 cases. That the typhoid bacillus has a distinct tendency to attack the gall-bladder is beyond doubt, and many cases have been recorded of acute cholecystitis occurring during the course of, or shortly after, an attack of typhoid fever, although they are relatively rare. Thus Thomas<sup>102</sup> reported 4 cases of post-typhoid cholecystitis, in 2 of which the *B. typhosus* was isolated, but in 895 cases of typhoid there were only 12 in which cholecystitis was noted (1.3 per cent.). But from the literature he collected 154 cases of typhoidal cholecystitis, gall-stones being present in 31. The *B. typhosus* was present in the gall-bladder in 50 per cent. of all the cases, or perhaps in 95 per cent. of these occurring during the course of typhoid fever. Ashurst<sup>4</sup> found only 18 cases of cholecystitis in 2864 cases of typhoid, but Quénu<sup>88</sup> was able to collect as many as 45 cases, from the literature, which had been operated upon. Although the above cases are chiefly those in which the gall-bladder lesion has occurred during or soon after the typhoid infection, it must be remembered that in the majority of cases the patient may not seek treatment for the gall-stones until many years afterwards. Thus in the 20 cases in this series, although in one gall-stones were discovered 4 months after the typhoid fever, the average time that had elapsed was 20 years, and in one case it was as long as 56 years, although here there was no note of any bacteriological examination of the bile. In a case recorded by

Dean<sup>22</sup> typhoid bacilli had remained and were found in a typhoid carrier 29 years after the original infection. When dependent in this way upon typhoid fever, cholecystitis may occur in young children. Thus Armstrong<sup>2</sup> records a case of perforation of the gall-bladder from such a cause in a child of 10 years of age, and Moynihan<sup>74</sup> states that he has operated upon seven patients under the age of 21 for gall-stones, in all of whom there was a history of typhoid fever, and in two of them the *B. typhosus* was discovered in the bile.

Most observers therefore are in agreement that the evidence of an inflammatory factor is very strong. Aschoff and Bacmeister<sup>3</sup> on the other hand claim that pure cholesterin calculi may be formed by stasis alone without infection or inflammation of the gall-bladder. Bacmeister<sup>5</sup> states that the deposition of cholesterin is favored by the gall-bladder epithelium, but sterile bile *in vitro* at body temperature can precipitate cholesterin without noteworthy admixture of calcium. They state that they have found pure cholesterin calculi only in gall-bladders free from inflammation, and believe that cholesterin comes only from bile and not from the epithelium of the gall-bladder. Should there be inflammation, it is secondary to the calculus and due to the irritation of it. If this be so, one would expect to find pure cholesterin calculi in the common duct, but in this series I have not found this to be the case; pure cholesterin calculi have nearly always been those impacted in the cystic duct, and if one of many in the gall-bladder become so impacted, it becomes covered with a layer of pure cholesterin as will later be described. It seems, therefore, much more probable that such stones are formed, not because there is an absence of any inflammatory change, but because the pigment is shut off by the impacted calculus. They admit that calculi may be produced by inflammation, but state that such calculi are always rich in calcium either as the carbonate or combined with pigment. In this series of cases 10 were noted as having pure cholesterin calculi, all single. In 5 of these a bacteriological examination of the fluid was made. Three contained *B. coli*, 1 *Staphylococci* and 1 was

sterile. There were also 11 cases in which one of many calculi in the gall-bladder had become impacted in the cystic duct, this calculus having then become coated with a layer of pure cholesterin. Four of these had been examined bacteriologically; 1 was sterile, 1 contained *B. coli*, 1 *B. typhosus*, and 1 a *Staphylococcus*, thus pointing to the fact that even with pure cholesterin calculi there is a chronic infection of the gall-bladder.

### *Methods of Infection.*

The organisms which give rise to infection in the gall-bladder might reach their destination by the following routes: (1) from the intestine, passing up along the cystic and common ducts; (2) along the portal vein; (3) by means of the systemic circulation.

The nature of the organisms present in such cases might throw light upon the source of infection. As pointed out, all observers are agreed that organisms of the coli group are those most frequently found, and this would at first sight strongly point to the infection having taken place either along the common duct or up the portal vein. Certain indirect evidence has also been brought forward in favor of the infection passing along the common duct. Thus MacCarty<sup>59</sup> records two cases where duodenal ulcers blocking the papilla of Vater were associated with gall-stones and cholecystitis, which he suggests points to an ascending infection. It is, however, equally open to suggestion here that the duodenal ulcers were due to an infection passing down to them from the gall-bladder. Lippmann<sup>56</sup> has isolated organisms from the common duct in numbers decreasing upwards, and Kelly<sup>49</sup> states that with gall-stones the bacteria are not infrequently more numerous in the lower end of the common duct than elsewhere in the biliary tract, the motile being more common than the non-motile organisms.

As Stanmore Bishop<sup>100</sup> has pointed out, however, the method of ascending infection is unlikely, for the duodenum is singularly free from micro-organisms, and even if present such organisms as are found in the intestine are of a virulence

more likely to cause an acute cholecystitis than to lead to the formation of gall-stones; moreover, the organisms are not likely to ascend against the bile stream.

There is considerably more evidence that the infection takes place through the blood stream. Thus Doerr<sup>24</sup> injected organisms into the veins of rabbits and recovered them from the gall-bladder within a few hours, catarrhal changes of this viscus being also present. Lemierre and Abrami<sup>54</sup> confirmed this. They injected *B. typhosus* into the vessels of a rabbit's ear and found the organisms constantly eliminated by the liver, so that they passed into the bile-ducts and caused a transient cholecystitis. They were, however, unable to isolate the organisms from the bile after inoculating the stomach with cultures through a tube. Lartigan<sup>51</sup> showed also by experiment that if animals were fed on *B. pyocyaneus*, after ligature of the common duct, over one-half of them contained this organism in the gall-bladder.

As to whether the portal or the systemic circulation is the chief path of infection is somewhat doubtful. Owing to the work chiefly of the Italian physiologists, much stress has been laid upon the fact that one of the functions of the liver is a protective one, and that it excretes toxins and organisms absorbed by the portal system and hence a cholecystitis might be set up which would probably be chronic in nature, owing to the virulence of the organisms having been decreased by the action of the liver. Adami<sup>1</sup> has also emphasized the importance of the portal system as a means whereby infection is carried to the gall-bladder. Ochsner<sup>79</sup> has even gone so far as to suggest that in all cases the portal of entry for the organisms was a diseased appendix, but as MacCarty<sup>59</sup> points out, it is strange that gall-stones are so rare in young children, if such be true, whilst appendicitis is so common. He found that in 59 cases of gall-stones, 67 per cent. presented definite gross and macroscopical changes in the appendix, but he states that chronic changes in the appendix are so often found post mortem in apparently normal people that he doubts the value of these figures. In a later communication, however,

he and McGrath<sup>60</sup> find that, whereas in general postmortems only 17 per cent. show obliteration of the appendix lumen, in cases of cholecystitis and cholelithiasis, 44.8 per cent. show this obliteration, which obliteration they accept as evidence of a previous appendicitis.

Carmichael<sup>17</sup> was unable to find any infection of the gall-bladder after he had injected the portal system of rabbits with *B. typhosus*, *B. coli*, and *Streptococci*. This, combined with the work of Doerr<sup>24</sup> and Lemierre and Abrami<sup>54</sup> mentioned above, is much in favor of the infection passing along the systemic circulation, as are also the cases reported by Bryan and Kayser.<sup>14</sup> These authors found the specific organisms in the gall-bladder in cases of influenza and pneumonia, where presumably infection could not have taken place through the portal system. It will have been noticed that in this series of cases also there were three cases in which pure cultures of pneumococci were alone obtained from the gall-bladder.

The combination of facts that gall-stones are so much more common in women, that the *B. coli* is so much more frequently the organism present, and the fact that *B. coli* infections of other organs, especially the urinary tract, are very common in women and relatively rare in men, is suggestive that this organism is carried to the gall-bladder by means of the systemic circulation, and one is led to infer that the presence of gall-stones is often only a manifestation of a chronic septicæmia, and in this way is probably closely connected with the formation of urinary calculi.

### *Methods of Formation.*

Having seen that calculi are dependent upon inflammatory changes in the gall-bladder, and that cholesterin is thereby formed in excess, it remains to be shown how this cholesterin is deposited from solution in the bile and how the different varieties of stone arise.

In the case of the pigment calculi, Hunter<sup>45</sup> states that bilirubin itself is never precipitated, but under certain circumstances it combines with calcium, this compound then being precipitated. Under ordinary circumstances bilirubin and

calcium cannot be made to combine. The addition of lime water leads eventually to a precipitation of bilirubin calcium, but this precipitation is hindered by the presence of bile salts, and only takes place with excess of lime water. He points out that, although it has been suggested that precipitation is brought about by excess of lime in the drinking water, there is no evidence that the drinking of such water increases the amount of calcium in the bile.

Naunyn<sup>78</sup> first showed that the presence or absence of albumin had a very important bearing, and that if egg albumin be added to bile it brings about a precipitation of bilirubin calcium. Doerr<sup>24</sup> has definitely confirmed this by experiment, and Hunter<sup>46</sup> states his belief that the precipitation is caused by an increased viscosity of the bile, in its turn caused by an inflammatory catarrh of the ducts. The albuminous fluid would be formed during any chronic infection, and thus further evidence is provided of the dependence of this condition upon some inflammatory change. The effect of stagnation of the bile in aiding this infection has already been described. When combination of the pigment and calcium has taken place, the insoluble material will be precipitated, usually in the form of gritty particles. At times these will combine to form a soft, friable calculus, and since, as has been shown, cholesterin is only formed from the gall-bladder mucosa, therefore all calculi formed within the intrahepatic or hepatic ducts will be formed of pure biliverdin or bilirubin calcium. In four cases only of this series was there any note as to the presence of stones in the hepatic ducts; in three of these the calculi were soft, friable masses of pigment calcium, whilst in the remaining case, where the calculi were apparently of the common mixed variety, a large number of calculi were also present in the gall-bladder and common duct, and thus it is probable that they had not been formed *in situ* but had passed upwards from the common duct. When small, however, these pure pigment calcium calculi may pass into the gall-bladder, and acting there as foreign bodies, may become coated with cholesterin and form the nucleus of a calculus. A very large number of the more common varieties of calculi

contain pure pigment calcium in the centre or the pigment may have a simple layer of cholesterin deposited upon it as in Plate I, Figs. VI and VIII.

In the case of the gall-bladder also, the question is much less simple than would at first sight appear. Naunyn<sup>78</sup> believed that, owing to the inflammatory condition of the epithelium, the cholesterin was simply formed in excess and was then deposited in a crystalline form on the surface of the calculus, or in the earlier stages simply upon the surface of flakes of shed epithelium, but that such is not the case is clearly shown by the fact that the fresh layers are at first amorphous but may later become crystalline. Mayo Robson<sup>82</sup> brings forward evidence to show that gall-stones are more common in those who limit their nitrogenous diet, and that although according to Thudicum,<sup>103</sup> they are unknown in wild animals, they may occur in domesticated ones. He believes that thereby the bile salts are diminished and the cholesterin thus thrown out of solution. This fact, however, might be explained by the greater liability of domesticated animals to chronic infections.

Of late much work has been done upon the method of formation of urinary calculi, and it is probable that the facts discovered in reference to them, are true, in part, at least, in the case of gall-stones. Ord<sup>83</sup> first showed that the presence of colloids was a very important factor in the formation of such calculi, and Schede,<sup>97</sup> working upon the same lines, points out that in addition to the salts, colloidal substances are present especially in pathological urines. He refers to the work of Ebstein showing that an urinary calculus is not a simple aggregation of crystals but possesses a characteristic organic frame-work in which are embedded crystalline salts. The colloids occur in the form of numerous small particles or droplets, and thus the suspended colloid presents an enormous total surface area. This surface will attract and absorb a certain amount of the crystalloid in solution, which is held there more highly concentrated than elsewhere. Hence the effect of a colloid is to greatly increase the amount of crystal-



loid which can go into solution. If, now, the concentration is steadily increased, precipitation will first occur in the most concentrated parts, *i.e.*, on the surface of the colloidal particles, and thus when sedimentation occurs they will separate out together as amorphous particles. If the colloid be reversible, *i.e.*, capable of going into solution again, such as mucin for instance, the precipitate will be redissolved when the solution becomes weaker in crystalloid. If, however, it be irreversible, and the best example of such a colloid is albumin, then the precipitate will not be redissolved, but as Schede<sup>97</sup> has shown, it will contract and form a firm calculus. If precipitation occurs intermittently, a concentrically laminated calculus will result.

In favor of these factors applying also to gall-stones, we have the fact that the newly deposited material is always amorphous, that later it may contract and form a firm calculus or even undergo crystallization, that an albuminous framework usually described as a cement is always present, and that the calculi are not capable of being redissolved.

Therefore there is evidence that the presence of albumin or some other colloid is probably essential for the formation of calculi both in the ducts and in the gall-bladder. This albumin is provided by the inflammatory change which has already been shown to be so constant a factor, and which in the case of the gall-bladder also leads to the excessive formation of cholesterin.

The calcium may be simply derived from the calcium salts present in the bile, which under the influence of the albumin are capable of combining with the pigment, or, as Upcott<sup>105</sup> states, it may be mainly derived from mucous glands, which although present in very few numbers in health, are found in large numbers in the inflamed fundus.

Another factor upon which much stress has been laid is the presence of foreign bodies around which the material is deposited. Gérard<sup>36</sup> showed that a solution of bile salts saturated with cholesterin deposited the latter when inoculated with *B. coli*. Mignot<sup>70</sup> experimentally produced calculi in a

dog. The gall-bladder was artificially infected with an attenuated culture of *B. coli*. Six weeks later a thread was introduced into the gall-bladder, one end being attached to the wall. Five months later the gall-bladder was opened and two cholesterin calculi were found on the thread. Homans<sup>44</sup> has brought forward somewhat similar evidence from the human subject. In his case a suture was accidentally left projecting into the gall-bladder after an operation for calculi. Twenty months later a second operation was required for recurrence of symptoms. Calculi were found surrounding the previous suture and were removed.

In other cases portions of epithelium or even bacteria themselves may act as a central nucleus upon which the calculus is gradually deposited.

The mechanism of the formation of the calculi may therefore be summed up as follows: *B. coli* or other organisms are absorbed into the blood stream probably from the intestine. These organisms are carried to the gall-bladder and ducts by the blood stream, a chronic cholecystitis being thereby set up. Cholesterin is formed in excess, and a colloid material is at the same time set free in the bile. The cholesterin and pigment calcium are deposited from this in an amorphous state to form the starting point of a calculus. The deposit often occurs around some small solid particle as a nucleus. The nucleus may be single, or a large number may be present, and thus a single or multiple gall-stones may arise.

The material acting as a nucleus is usually free within the bile, but apparently in some cases the cholesterin as it is formed may remain adherent to the epithelium, so that multiple small calculi appear embedded in the mucosa. Moynihan<sup>73</sup> has recorded three such cases in which he found multiple small cholesterin calculi firmly adherent to the mucosa, the condition being sharply terminated at the commencement of the cystic duct. Bland Sutton<sup>10</sup> figures a case where the mucosa had completely sloughed owing to an acute infection; it was dotted all over with small calculi.

In the case of the common variety of calculus new material

is added around the nucleus, and one of the most characteristic facts is that this material is laminated. The reason for this is difficult to see. As already stated, Schede<sup>97</sup> has shown that artificially formed urinary calculi may be laminated, and the explanation may therefore in this case also be that precipitation occurs irregularly, but here the laminæ have different structures, usually alternating layers of cholesterin and pigment calcium. In some cases the layers of pigment calcium may vary both in thickness and nature, so that some of the layers are formed of biliverdin and others of bilirubin calcium. In the majority of cases, however, the laminæ are the same throughout. It is possible that the lamination is due to the presence of bile within the gall-bladder being spasmodic, either from intermittent obstruction of the cystic duct from the gall-stones or from catarrh of the cystic duct acting in the same way. In any case the calculi in the gall-bladder are always of the same structure—if one is of the common laminated variety they are all of this variety.

When first formed these calculi are quite soft, and in all cases the outer layers are noticed to be so when the stone is removed. Later the material becomes much firmer, and the cholesterin, as Naunyn<sup>78</sup> first pointed out, becomes crystalline, hence in the larger calculi, the inner layers of cholesterin are generally crystalline.

Partly owing to the softness of the newly deposited material, but more especially to the fact that as they enlarge they must fit into one another, these calculi always show facets, and if a large number be present they form a most perfectly fitting mosaic, the faceted surfaces accurately articulating with one another and being perfectly smooth and polished.

In many cases three or four stones may form a column within the gall-bladder, reaching from the fundus to the cystic duct, and so accurately do the opposed surfaces articulate with one another that it has often been suggested that they have arisen from the fracture of a single calculus. That such is not the case is readily shown by the fact that on section these calculi will always be found to be laminated around their own

and not around a common centre. The same is true at least for the inner portions in those cases which Bland Sutton<sup>10</sup> has drawn attention to and has figured, in which three calculi form a barrel-like mass partly filling the cystic duct and neck of the gall-bladder.

If the stone be single, it will steadily grow in size, the gall-bladder generally closely embracing it so that it is roughly oval in shape, has no facets, but often shows a roughened surface, the irregularities of which may closely fit the depressions of the mucosa of the gall-bladder. In other cases single stones may be more irregular in shape owing to the inflammatory condition having led to distortion in the shape of the gall-bladder. Thus this viscus may be partly constricted in the centre, leading to the formation of a dumb-bell calculus. In the same way calculi may be formed in pouches or diverticula of the gall-bladder, and especially in Hartmann's pouch at the commencement of the cystic duct. If one of these large single calculi be divided, well-marked laminæ are seen. These are always best marked near the periphery. In the centre an irregular homogeneous mass is often seen. This may be due to secondary changes in the central material or is more probably due to the fact that the nucleus was formed of pigment calcium, which had passed down from the hepatic ducts. In some cases the centre is seen to be formed of an irregular mass of almost pure cholesterin, and it is then almost certain that the secondary changes which Naunyn<sup>78</sup> described have taken place. He stated that in the course of time bilirubin calcium could be dissolved out from the centre of a calculus and be replaced by cholesterin. He said that this condition might go so far as to lead to a complete metamorphosis of the calculus, a laminated calculus being ultimately replaced by one of pure cholesterin. It is almost certain, however, that this does not progress so far, cholesterin stones arising, as will be described, in a different manner.

The structure of the mixed but non-laminated calculi (Plate I, Fig. III) is probably explained by the fact that the deposition is not intermittent but regular, and hence the calculus will have the same structure throughout.

It is difficult to determine how long a time is required for the formation of definite calculi within the gall-bladder. Probably in most cases it is a matter of years. Mignot<sup>70</sup> states that it requires 6 months to form a well-stratified biliary calculus. Herz<sup>43</sup> records an interesting case of gall-stones with *B. typhosus* in the gall-bladder and centres of the calculi. The calculi were removed 69 days after the onset of the first attack of typhoid fever. They varied from  $\frac{1}{8}$  to  $\frac{1}{4}$  inch in diameter. In one case in this series the first attack of typhoid had occurred 4 months before; at operation 20 calculi, the largest being  $\frac{3}{4}$  inch in diameter, were removed.

Stones thus formed in the gall-bladder may pass into the cystic duct and their onward process be then stopped. Further changes in the calculus will then depend upon whether the duct is completely occluded or not. If not, the stone or stones will grow *in situ* and since all the materials which are present in the gall-bladder will still be present in the fluid around them, the newly formed material will have the same composition as the original calculus. In this way stones perhaps in a series of two or three, closely articulating together, will form a barrel-shaped mass as described by Sutton,<sup>10</sup> which is much too large to have reached this situation by mere passage down the ducts. Such stones will in the majority of cases be found to have lost the typical laminated appearance in their outer layers, which is probably explained by the fact that in this position there is more or less constant flow of fluid around them, and hence deposition on their outer surfaces is less intermittent.

If the obliteration be complete, the course is somewhat different. In this case the bile pigment coming from the liver is unable to pass back to the gall-bladder. This latter structure, however, owing to its inflammatory state, continues to secrete mucus and cholesterin. Hence the newly deposited material will consist of practically pure cholesterin, and if the obliteration has taken place when the calculus was small, this latter will be found almost wholly formed of pure cholesterin. So constant is this that if there be only one stone

which is completely obliterating the cystic duct or neck of the gall-bladder, this stone will generally be of pure cholesterin. The converse of this is even more constant, *i.e.*, that a pure cholesterin stone will be found to be the only stone and will be obliterating the cystic duct or neck of the gall-bladder, for in the former case the calculus may have been formed in the gall-bladder, and although it has passed down to the cystic duct, may not yet have become coated with cholesterin.

If at the time of obliteration there be a considerable amount of bile in the gall-bladder, the calculus may be evenly pigmented throughout, although formed of cholesterin as in Plate I, Fig. II.

That such is the method of formation of these calculi is shown by the case in Plate II. Here the gall-bladder contained a large number, several hundreds, of common facettèd calculi. The cystic duct, however, was obstructed by a larger and more irregular calculus. At first sight this appeared to be of pure cholesterin, but on cutting it open the centre was seen to be formed of a calculus similar to those in the gall-bladder, around which the cholesterin was deposited. The truth of Naunyn's contention, that secondary changes can take place in a calculus, is also well shown, for the outer laminæ of the original calculus are very irregular and are evidently in the process of being absorbed and replaced by pure cholesterin.

#### ETIOLOGY.

The true frequency of gall-stones is of course difficult to estimate. In post-mortem subjects only, Brockbank<sup>13</sup> finds that in Manchester they form 4.4 per cent., whilst Mayo Robson<sup>62</sup> for Europeans of all ages and sexes places it at 5.12 per cent. In the three years, 1908 to 1910 inclusive, 3755 post-mortem examinations were performed at the London Hospital. Among these there were 131 cases of gall-stones giving only 3.48 per cent. Among the total population the frequency is much less, but cannot be estimated with any accuracy. The 409 cases of this series, which were confirmed

by operation, occurred among a total of 76,410 cases of surgical in-patients, in the ten years, this giving 0.53 per cent.

*Age.*—Gall-stones are extremely rare to young children, most cases being found between the ages of 30–60. Thus in this series of 409 cases, the numbers occurring at different ages were as follows:

Age.	Number.	Age.	Number.
1–10 .....	0	51–60 .....	123
11–20 .....	0	61–70 .....	63
21–30 .....	26	71–80 .....	11
31–40 .....	68	81–90 .....	1
41–50 .....	117		

As Moynihan<sup>74</sup> points out, however, in a large number of cases symptoms have been existing for many years, and thus the age frequency will to a large degree depend upon skill in diagnosis, and in older series where a definite diagnosis was not made until colic and jaundice were present, the age would be considerably higher. The following table gives the age frequencies in this series when symptoms first appeared.

Age.	Number.	Age.	Number.
1–10 .....	3	51–60 .....	67
11–20 .....	27	61–70 .....	27
21–30 .....	57	71–80 .....	5
31–40 .....	122	81–90 .....	0
41–50 .....	101		

According to this latter table the age of onset is most commonly found between 31–40, which is in agreement with the figures of Moynihan,<sup>74</sup> who gives it at 40, and of Hartmann,<sup>42</sup> who states that they most commonly commence before the age of 35.

It will be seen from the above tables that not a single case occurred in a patient below the age of 20, although in 30 cases there was a history of symptoms having commenced before that age. Occasionally gall-stones may be found in quite young children or even in infants. Thus Still<sup>101</sup> was able to collect records of 23 cases, including 3 of his own. Ten of

them were in still-born children or in young infants. Portal and Lieutard<sup>86</sup> also described them as being present in the newly born.

The nature of such calculi is difficult to see, as in patients of such an age inflammatory changes in the gall-bladder would be very unlikely. It is interesting to note that in two of Still's cases the calculi were pure bilirubin calcium.

*Sex.*—The condition is much more common in women than in men. In this series of cases there were 347 women or 87.3 per cent., and 62 or 12.7 per cent. men. In Brockbank's<sup>13</sup> post-mortem series gall-stone cases formed 7.9 per cent. of female and 2.9 per cent. of male autopsies, whilst Schroeder<sup>98</sup> found in Strasburg 20 per cent. in female and 4.4 per cent. in male autopsies, which would point to gall-stones being more common there than in England.

Many explanations have been given of this greater frequency in women, most of which explanations aim at finding some mechanical cause of obstruction with consequent stagnation of the bile. Thus it is often stated that it is due to the fact that women wear corsets. By their use the antero-posterior diameter of the lower thorax and upper abdomen is decreased, and hence the gall-bladder is pressed backwards, the angle which its neck makes with the cystic duct being thereby decreased and the flow of bile hindered.

It is again stated that women take much less exercise than men. The voluntary abdominal muscles are thus weaker, and their action in emptying the gall-bladder is decreased. This factor is, however, probably of but slight importance, for in this series the difference between the two sexes is very marked, and yet these women, drawn as they are from the poorer classes of the community, generally have to do extremely hard manual work and often show a muscular development relatively equal to that of the males. Since, however, enteroptosis is often associated with gall-stones, and this condition, as Keith<sup>48</sup> has shown, is mainly dependent upon loss of power of the abdominal muscles, loss of muscular development may indirectly act as a causative factor.



Although the above factors may be predisposing causes, it is probable that the tendency of women to become infected with the *Bacillus coli* is of much greater importance in determining the presence of gall-stones. As already shown, this organism is the one most commonly found in cases of gall-stones, rather less than 50 per cent. of the cases being apparently dependent upon it. All writers are agreed that urinary conditions due to the *Bacillus coli* are also much more frequent in women than in men. Thus Brewer<sup>12</sup> found that 84.6 of his cases were females, figures which correspond very closely with those for gall-stones. That there is a very close connection between gall-stones and urinary disease is shown by the fact that of the 347 female cases in this series there were 73 or 21 per cent. showing well-marked urinary symptoms, such as pain, frequency, and albuminuria, and when it is remembered that in a large number of cases bacilluria with *B. coli* may exist with no symptoms, it is probable that the percentage was much higher than this. In pursuit of this question, I have had bacteriological examinations made of the urine in ten cases of gall-stones showing no urinary symptoms. In 7 of these the *B. coli* was present on culture, and although these figures are too small to carry any weight, they are at least suggestive that both pyelitis and cholecystitis are but part of one disease, a chronic *B. coli* septicæmia.

As to why women should be more prone than men to become thus infected is not clear. Pregnancy may be an important factor. Naunyn<sup>78</sup> first showed that 90 per cent. of all cases of gall-stones in women had been pregnant—figures which are closely in accordance with those of this series, 324 out of the 347 cases having been married women. The results of examination of various urines as recorded by Dudgeon<sup>28</sup> are of great interest from this point of view. The urines obtained from normal men contained in no instance any *B. coli*. From 20 cases of constipation it was obtained twice, from 20 cases of peritonitis four times, and from 45 cases of pregnant women ten times, showing the greater tendency of pregnant women to *B. coli* bacilluria.

Pregnant women are also prone to suffer with an infection of the kidney usually described as "pyelitis of pregnancy," which condition is usually due to the *Bacillus coli*. Thus Ward<sup>107</sup> found this organism present in 44 out of 56 cases, and Macaigne,<sup>58</sup> Brewer,<sup>12</sup> and French<sup>31</sup> have shown that here also the organism probably reaches the kidney from the blood stream.

Another factor which may be of some importance is the much greater frequency of constipation in women, thus aiding in the absorption of the organisms from the intestine. In cases of gall-stones constipation is so frequent as to be noted in nearly all text-book descriptions of this disease.

When once the bacilli have gained access to the gall-bladder, any condition leading to stagnation of the bile could aid them in obtaining a foothold therein.

#### SYMPTOMS OF CALCULI IN THE GALL-BLADDER.

In a certain number of cases gall-stones may exist in the gall-bladder and give rise to no symptoms. Formerly this was believed to be quite common because many cases were discovered to have calculi post mortem, when no history of colic or jaundice had been obtained during life. Since Moynihan<sup>74</sup> and Mayo Robson,<sup>63</sup> however, have laid so much stress upon the fact that such symptoms only occur late, it is realized that many of these patients have had earlier symptoms which had been overlooked, and thus all these statistics become valueless. Probably very few patients are quite free from all symptoms, although it is undoubted that they may be free for many years. Thus cases may be admitted to hospital with severe cholecystitis due to the presence of many or large calculi, and only complain of a sudden onset of symptoms a short time previously. Although the calculi must have been present for months or years, no history of the earlier symptoms can be obtained. In other cases extensive chronic changes may be present in the gall-bladder, and a calculus may even ulcerate through into the intestine, and although, after the condition has been made clear the patient

may be closely examined as to the presence of past symptoms, in some cases no note of any such can be obtained.

In this present series there were 28 cases in which no symptoms whatever had been noticed until the onset of some acute complication, such as acute cystitis, rupture, impaction of the calculus in the cystic or common ducts, or acute intestinal obstruction. In each case the condition found at operation was such as to suggest that the calculi must have been present for a long time previously, and yet the patient denied any of the earlier symptoms which would have been expected.

In uncomplicated cases of calculi within the gall-bladder the most constant symptom is pain, of which, as Moynihan<sup>74</sup> points out, there may be two varieties.

*Local Pain.*—This is usually described by patients as indigestion, attacks of biliousness, or windy spasms. They complain of a dull aching or gnawing pain in the epigastrium and right hypochondrium, coming on soon after food. With it there is a sense of fulness and of having eaten too much, often accompanied with flatulence and actual distention, so that the clothes have to be loosened in order to obtain relief. In some cases there may be tenderness in the epigastrium and hypochondrium. The symptoms are generally relieved by the eructation of wind or rarely by vomiting. In such cases the condition may closely simulate gastric disease, especially as the symptoms, as Moynihan points out, may vary with the nature of the food taken.

In many cases this pain may exist for many years as a typical dyspepsia to be followed later by more severe symptoms. In this present series 185 cases gave this symptom as the earliest noted, although in seven cases only was it the only evidence of calculi. In the majority of cases it had existed for years, but treatment was not sought until other evidence of the disease had arisen. In three cases alone did this symptom appear later, that is after other signs of the condition had become manifest.

Of the cause of this symptom there is some doubt, but the

fact that the pain comes on shortly after food, that it only lasts a relatively short time and is relieved by vomiting or a decrease in the tension of the stomach, is suggestive of the fact that it is dependent upon dilatation of the gall-bladder by the physiologically increased flow of bile, the normal painless filling of the bladder being prevented by the presence of the calculi. It is probably increased by the contractions of the gall-bladder occurring with digestion. This belief is supported by the fact that in the seven cases having no other symptom, the gall-bladder was normal in appearance, showing no adhesions or macroscopical inflammatory change.

*Diffuse Pain.*—In these cases the pain is more severe, it is constant, but is subject to severe exacerbations after meals. It may arise as the earliest symptom or occur as a sequela to the last described condition. In a typical case the patient will describe attacks of severe pain in the right hypochondrium and epigastrium, radiating to the back and one or other shoulder, most commonly the right. At times it may pass over to the left side or to the right iliac fossa. As a rule the pain comes on in attacks which may last for a week or more, during which time it is constant, but likely to be increased by taking food. Although severe the pain is bearable and not to be confounded with the agony of true colic. With the attacks of pain there is vomiting, often of bile-stained material, headache, and a feeling of general ill health. The skin may be cold, and slight shivering attacks not sufficient to amount to rigors be present. Such attacks may often be described by the patients as severe bilious attacks. In some cases the pain may be worse at night and may be relieved by food, when a duodenal ulcer is closely simulated, and in fact a differential diagnosis may be impossible.

With the attacks of pain there is usually tenderness of the gall-bladder, so that if the patient be directed to take a deep breath there is a sudden deep stabbing pain in the right hypochondrium associated with a "catch" in the breathing. The best method of eliciting this tenderness is that suggested by Murphy.<sup>77</sup> The surgeon's fingers are hooked up deep be-

neath the right costal margin and the patient instructed to take a deep breath. As the tender gall-bladder impinges upon the resisting fingers, the inspiration suddenly ceases as though it had been cut off.

In some cases the upper right rectus may be distinctly rigid, and deep tenderness be at once obtained in the right hypochondrium. The pain then may be even more diffuse and pass down the right arm or be most marked in the right iliac fossa, so that the condition may be mistaken for appendicitis, although it must be remembered that there is at times an association of these two conditions as pointed out by Ochsner,<sup>79</sup> MacCarty and McGrath.<sup>80</sup>

Often there is an area of superficial tenderness on the right side behind at the level of the twelfth dorsal vertebra and two to three fingers' breadth from the spine. This sign was first described by Boas.<sup>11</sup> He states that this area of superficial tenderness is present in the majority of cases, and if present in the acute attack is invariably found in the intervals, but if absent in the acute attacks it is absent in the intervals.

In 117 cases of this series this was the first symptom of which the patient had complained, while in 71 cases this more severe diffused pain only appeared after the patient had complained of dyspeptic pain for some years. In two cases it was only noticed after several attacks of colic and jaundice.

The facts that these symptoms are likely to occur in severe attacks superadded to the constant pain, that there is local tenderness with rigidity and referred pain, that there is general malaise, and that the symptoms are almost identical although not so constant as those found with some cases of suppurative cholecystitis are very suggestive that the condition is due to chronic or subacute inflammatory changes in the gall-bladder. In nearly all the cases in the above series it was noted that the gall-bladder was inflamed, adherent, or fibrotic and contracted.

(To be continued.)

# SOME MODIFICATIONS OF TECHNIC IN THE SURGERY OF THE GALL-BLADDER AND BILE-DUCTS.\*

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EXPERIENCE to date has developed successful lines of surgical procedure in the operative technic of cholecystostomy, cholecystectomy, choledochotomy, cholecystenterostomy, and several rare operations on the gall tracts. In my judgment, when the most reliable life-saving operations are to be chosen, sufficient importance has not been placed upon, first, the condition of the patient at the time of operation, and, second, the local findings after the abdominal incision has been made. The writer published eleven years ago in the *Philadelphia Medical Journal*, a technic for cholecystostomy which had in principle the formation of a channel for drainage, lined by peritoneum (a continuous peritoneal drainage route). For several years prior to this publication, I had found by following out this principle that the danger of a fistula was avoided in all cases when the route to the duodenum via the cystic and common bile-ducts was free. Formerly it was not an infrequent experience that, like an intestinal fistula, the mucosa of the gall-bladder became attached to the abdominal incision, like the mucosa of the intestine, so as to cause a similar fistula.

The technic which I published and illustrated in 1900 is that generally advised by text-book writers; some few modifications have been made: Drs. Mayo, in Keen's "Surgery," vol. iii, p. 1017, illustrate and describe my technic, as modified by a purse-string suture. The original technic is well illustrated in Jacobson and Rowland's "The Operations of Surgery," vol. ii, and also by Binnie. I have called attention to this technic because it is the one in use to-day by most sur-

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\* Read before the American Surgical Association, June 21, 1911.

geons, but too few seem to realize its limitations, at least their writings and my observations of their work have so impressed me. There are contraindications to the attempted employment of the usual technic of cholecystostomy, when from the situation or size of the gall-bladder it is impossible to sew it to the parietal peritoneum without loosening the peritoneum on each side of the abdominal incision, so that these flaps of peritoneum can be depressed and attached to the gall-bladder. This technic (introduced by Mayo Robson), although in some cases practicable, is never a wise procedure because it results in the formation of painful and maybe dangerous adhesions; it is entirely unnecessary. If the drainage tube is properly fastened into the gall-bladder, nature, in a few hours, protects the tract of the drainage tube by limiting adhesions. A cigarette drain may be employed to still further establish a protective route for the drainage tube, and a gutter of omentum may be arranged as a further protection.

Whenever the gall-bladder walls are infiltrated so that a safe and easy invagination of them is difficult, no attempt in this direction should be made. Many surgeons under such circumstances sew a drainage tube into the gall-bladder and then sew the gall-bladder to the peritoneum of the abdominal incision. There is danger that a fistula may follow this technic—I have seen such results. My practice is, first, to excise the mucosa of the gall-bladder for a half to three-fourths of a centimetre around the periphery of the incision into it, and then fasten the drainage tube by a securely tied purse-string catgut suture introduced so as to exert sufficient pressure upon the mucosa beyond its excised border; this not only secures the tube and prevents hemorrhage, but also eliminates the mucosa in such a way as to prevent the formation of a fistula.

When infection is a marked feature of the contents of a gall-bladder, and its walls are thickened and oedematous, none of the methods of technic already described are suitable or safe. The object of treatment in such an instance is to provide drainage with the least trauma to the integrity of the gall-bladder walls, more especially to the mucosa, which may in

greater or lesser part be necrotic. Whenever possible, the soft adhesions surrounding such a gall-bladder should not be disturbed—rather one or more gauze packs may be introduced to still further insure the localization of the infection. The gall-bladder must be freely incised, and, if easily done without tension, sewed to the abdominal incision and drained with a tube. If tension would follow such suturing, introduce and fasten by a suture a good sized rubber tube into the gall-bladder, and by cigarette drains and gauze packs completely circumscribe the infected gall-bladder.

*In the absence of infection* cholecystectomy is a justifiable operation. An old contracted gall-bladder containing a calculus, *may* better be removed. Hydrops of the gall-bladder from an impacted calculus in the cystic duct or a stricture closure of the cystic duct may best be treated by cholecystectomy, compensation by hypertrophy of their walls and enlargement of their lumen having taken place in the hepatic and common ducts. However I must take issue with those who advise cholecystectomy in any acute infection within the gall-bladder extending into or beyond the cystic duct. Likewise I feel confident that more lives will be saved and fewer complications follow by avoiding cholecystectomy when infective inflammations are apparently confined to the gall-bladder, especially so, should there be gangrene of the gall-bladder.

All acute infections of the gall-bladder, empyema, gangrene either involving the mucosa alone or the muscular walls and peritoneum should be treated by simple incision and drainage after a protective gauze packing off of the peritoneal cavity. I have known disaster follow cholecystectomy in such cases—the crushing of the cystic duct and its artery, more especially of the poison laden lymphatics; the trauma to the peritoneum passing from the gall-bladder neck to the gastro-hepatic omentum, can and does in some such instances lead to a thrombophlebitis and fatal infections. In two cases I know of, there was sloughing of the stump of the cystic duct, destroying it so that the biliary fistula resulting communicated directly with the hepatic duct. Had the operative in-



terference been limited to free incision into the gall-bladder after gauze packing, the gangrene would probably not have extended; tension would have been relieved and had not nature brought about a cure the patient's improved general condition would have admitted of some one of the several plastic procedures being carried out. The removal of gall-stones from an infected gall-bladder should be done with great gentleness. In fact at times it is much wiser not to attempt their removal until the circulation is better established by the relief of tension following free incision of the gall-bladder fundus. The spooning out of gall-stones is always accompanied by more or less trauma to the mucosa of the gall-bladder, thereby in seriously infected patients opening up fresh foci for attack by the invading germs. The expression of enough of the stones through a free incision into the gall-bladder fundus by passing the fingers of one hand under the gall-bladder and raising it up against the under surface of the liver or against the fingers of the other hand as indicated, will limit trauma, reduce tension, and admit of temporary drainage. In these instances if the common duct is enlarged considerably and the gall-stone history of relatively long standing, this enlargement may not be a compensatory change, but one due to an impacted stone in the lower end of the common duct, and this duct should be incised and drained. I have the notes of a number of patients, teaching the wisdom of the practice advised, and I have seen death follow the more ideal technic. One particular fact has been impressed upon me: whenever upon incising an infected gall-bladder of a very ill patient, there is a foul odor to its discharging contents, no further trauma should be inflicted within the gall-bladder. If in such a case it is possible to reach the cystic duct it should be incised.

Open drainage and protective gauze packing are the best life-saving measures—these are emergency operations, and it is wonderful how seldom secondary operations are required.

Years ago in an emergency, I made an anastomosis between the common bile-duct and the duodenum; there was a stricture

of the cystic duct and also of the duodenal end of the common duct. The patient recovered.<sup>1</sup>

The anastomosis of the gall-bladder to the duodenum or other parts of the bowel is usually readily feasible and valuable in obstructions in the common duct and in chronic pancreatitis. Its exact position in the latter condition is not determined, but I am personally convinced of its value; if the temporary drainage of cholecystostomy is of value in the treatment of chronic pancreatitis, then the permanent drainage by cholecystenterostomy must be doubly so. When cholelithiasis is a complication of pancreatitis, the drainage should always be external, and possibly will be favored by the repeated forcing of water through the ducts into the duodenum as recommended by MacArthur. Likewise such treatment, cholecystostomy and duct washings, may be advisable whenever cholecystitis is a prominent symptom as a complicating or relapsing factor of typhoid fever. This surgical procedure should only be employed after the failure of vaccines. New infections may occur through the nurse taking care of typhoid patients not using proper "surgical" precautions, as the wearing of rubber gloves, etc. "The route from the bed-pan and urinal to the food tray is a short one." I have had made for me and use horse serum, each 10 c.c. containing 10 grains of calcium lactate, which I believe has been as a prophylactic measure of service in preventing possible hemorrhage in cholæmic cases.

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<sup>1</sup> Journal of the American Medical Association, March 10, 1900.

# MESENTERIC CYSTS.

WITH REPORT OF A CASE.

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THE following is the report of a case which has come under our observation, together with a résumé of the literature on the subject as regards the etiology, symptomatology, diagnosis, and treatment of mesenteric cysts.

CASE I.—E. H., aged eight years, female, was admitted to the Hebrew Hospital on October 23, 1910, complaining of pain in the abdomen and across the back.

The *family history* is interesting from the standpoint of neoplasms, her grandmother having died from cancer of the stomach, and her mother having had a tumor of the breast, which was removed when she was twenty-five years of age and which has not recurred.

Her *past history* is unimportant, except for the fact that she has been troubled with constipation and abdominal discomfort for several years.

*Present Illness.*—About two years ago patient began to complain of severe abdominal pain, especially at times when she was constipated, which was relieved by enemata or castor oil. At first these attacks of constipation with severe abdominal pains would occur about once every two weeks, but they have gradually become more frequent until at the present time, when they occur daily. Several months ago patient was in bed for three weeks with severe abdominal pain and vomiting, the vomitus being blood stained. She described the pain as severe and sharp, and states that she has a constant aching in her abdomen at all times. Has lost weight in the last year.

*Physical Examination.*—On physical examination patient found to be fairly well nourished, expression and color good. Examination negative except for abdomen. Just to the left of

the umbilicus a large mass could be seen. On palpation this mass was found to be movable and could be pushed from side to side or higher up in the abdomen, and apparently was the size of a cocoanut. The liver and spleen were not palpable, and there was no rigidity or tenderness made out except upon firm pressure over the tumor-like mass.

*Operation.*—Under ether anæsthesia abdomen was opened by a median incision, extending from an inch below the umbilicus to the pubes. After cutting into the peritoneum a cystic tumor about the size of a cocoanut jutted into view. The mass was multilocular, each lobe in itself being made up of many lobules. The tumor was located between the layers of the mesentery, about the middle of the ileum. Intestinal clamps were placed on the bowel on either extremity of the growth. The intestine was then cut external to the clamps, and the mesentery cut and clamped external to the growth. All bleeding vessels were ligated, and an end-to-end anastomosis performed. One small cigarette drain was inserted in lower part of the incision and the patient left the table in good condition.

Patient made an uninterrupted recovery, bowels moving three days later and drain removed four days after operation. She left the hospital twelve days after operation, cured. Her bowels moved daily and there was no abdominal discomfort whatsoever. She was seen four months after the operation when she was perfectly well. Had gained 30 pounds.

The growth involved practically the whole mesentery of the ileum and apparently originated close to the intestinal margin. It consisted of two cystic masses with a sulcus extending between them close to the bowel—the larger cyst mass involving 5 inches of the bowel and the smaller 3. The greatest circumference of the larger cyst mass was 9 inches and that of the smaller 7. The circumference at the sulcus between the two masses was 5 inches. The whole growth weighed 13 ounces.

The bowel measured 8 inches and the cut free mesenteric border 4 inches, which necessitated fixation of the bowel and caused moulding in a circular manner around the cyst. The bowel over the larger cystic mass was completely flattened owing to the tension produced upon it by the growing cyst, the cystic mass extending well out on either side of the bowel for at least two inches. The smaller cystic mass consisted of two cysts the

FIG. 1.



Mesenteric cyst together with resected bowel.

FIG. 2.



Microscopic section of cyst wall, showing  
lining of cylindrical epithelium.



size of hen eggs on either side of the bowel. These cysts were opened to obtain the fluid for examination and were found to communicate in the median line close to the bowel margin.

The walls of the cysts were thin, shiny, translucent membranes, and showed definite lines of smaller cysts within. The growth was so arranged that it could have easily become twisted upon itself with the bowel, where the two cystic masses met as a centre, and thus caused obstruction. This, no doubt, was the origin of the severe vomiting spells described above. A few small blood-vessels were noted traversing the cyst walls. One cyst at the junction of the larger and smaller cystic mass had a much thicker wall and was firmer than the rest of the cysts, and was the size of a pigeon's egg.

Sections were made from the larger and smaller cysts. Their walls were composed of fibrous tissue containing a few small cells, blood- and lymph-vessels. On their inner surfaces there were epithelial cells which were columnar in type, the protoplasm staining very little but the nuclei staining very well. Some of the nuclei were lying close to the basement membrane, but others were close to the secreting surface of the cell.

It is interesting to note that the contents from the minute cysts were gelatinous, and clear, while that of the larger cysts was watery, milky, opalescent, and bluish. On allowing the same to stand a shimmering deposit appeared on the surface. This proved to be, on microscopical examination, showers of cholesterin crystals. The total quantity of fluid removed was 115 c.c. The specific gravity was 1.016, and its reaction was neutral. The following were found on microscopical examinations: showers of cholesterin crystals, fatty acid crystals, fat cells, leucin globules, degenerated epithelial cells (some with and some without yellowish pigment), and fat droplets, which had the characteristic stain with soudan three. The total albumin was 14 grammes to the litre. The chemical tests were made for pseudomucin, but this constituent was lacking.

The appearance, microscopical and chemical analyses of this structure would at once remind one of the cystadenoma of the ovary, except for the absence of pseudomucin which is thought to be an important factor in these growths. The structure of the cystadenoma of the ovary consists of multiple cysts which are lined with columnar epithelium. The contents of the smaller cysts are gelatinous and clear, as described in the smaller cysts of this growth, and the larger ones are liquid and cloudy, as in the larger ones of this growth.

When we consider that up to the present time there are about 200 mesenteric cysts in all reported in the literature, we can well make the statement that they are amongst the surgical

rarities. The first record we have is of a case reported by Benevieni in 1507 which he found at autopsy. Indeed up to 1850 all cases reported were found at post mortem.

The history of mesenteric cysts has been divided by Braquehayé into three periods: First, the period commencing with Benevieni and extending to 1850, consisting solely of cases recorded at autopsy; second, from 1850 to 1880, during which time operations were occasionally performed for the removal of mesenteric cysts, but usually after an incorrect diagnosis, these cases generally terminating fatally; third, from 1880 until 1900, during which time interesting and helpful discoveries resulted in having the cyst diagnosed and operated upon successfully. We can very well add to the classification of Braquehayé a fourth period commencing at the time of Dowd's interesting theory, "the origin of mesenteric cysts from embryonic sequestration," and extending to the present day.

The most important workers in this field have been Portal, who classified them as early as 1803; Braquehayé, who in 1892 reported 104 cases of mesenteric cysts and classified them as follows: (1) sanguineous cysts or hæmatomas; (2) lymphatic cysts; (3) parasitic cysts or hydatids; (4) congenital cysts or dermoids; (5) cysts of joining organs, such as ovarian, parovarian, and pancreas; and Moynihan, who, in a very comprehensive article in 1897, also classified them as follows: (1) serous cysts, (2) chyle cysts, (3) hydatid cysts, (4) blood cysts, (5) dermoid cysts, (6) cystic malignant disease. In 1900 Dowd expounded a logical theory for the origin of mesenteric cysts, and based a classification on this theory which is more tenable than either of the previous classifications, his being as follows: (1) embryonic cysts, (2) hydatid cysts, (3) cystic malignant disease.

#### ETIOLOGY.

The etiology of these tumors is at present an unsettled matter, there being two schools,—Braquehayé-Moynihan-Porter and their followers, who adhere to the theory that mesenteric cysts are of multiple origin; and Dowd, who



claims that they are of embryonic origin, this being a modification of Cohnheim's theory.

Dowd states that in the development of the Wolffian body it is probable that portions of the germinal epithelium of some of the organs are separated and carried between the layers of the mesentery in the development of the alimentary canal. In later life these cells become activated and take on new growth. The fact that in the growth of various organs, such as the liver, suprarenal, lung, spleen, pancreas, and thyroid, accessory lobes are frequently found far from the organ itself is an argument in favor of this theory. Up to 1900 very little work had been done as to the origin of mesenteric cysts, no cyst wall had been examined microscopically, nor contents chemically. Dowd made tests and sections of a cyst and its contents and was struck by their marked similarity to the cystadenoma of the ovary and its contents. Since then a number of cases have been reported in which, after careful examination of their walls and contents, the tissues similar to those found in various organs of the abdomen have been found.

**VARIOUS FORMS OF MESENTERIC CYSTS.—*Blood Cysts.***—These cysts have been reported from time to time. Frequently a history of injury could be obtained from patients having sanguineous cysts, and these cases were, of course, suffering with simple hæmatoma. They are usually preformed cysts in which hemorrhage has occurred. The majority of mesenteric cysts are well supplied with blood-vessels and one can easily conceive how one of the inner vessels could rupture and produce hemorrhage within the cyst wall. According to Dowd's theory these cysts could well come in the class of embryonic cysts.

***Dermoid Cysts.***—A few dermoid cysts of the mesentery have been reported. Dermoids occurring in the abdomen have generally been considered ovarian in origin. According to Cohnheim they are ectodermal inclusions during fetal life and the growth of these elements at a later time. Langton reports a case in which both ovaries were involved with dermoid cysts and a similar structure found between the layers

of the mesentery. It is interesting to note that all mesenteric dermoids reported have occurred in females. Dermoids, therefore, are no doubt of ovarian origin.

*Chyle Cysts.*—This class constitutes the most common of mesenteric cysts. They contain a milk white fluid, and the microscopical appearance shows granular cells, some of which have undergone fatty degeneration, and the walls of the cysts are usually fibrous and firm. It has been supposed that these cysts are due to the dilatation of some of the lacteal or chyloferous vessels. It has also been suggested that there has been an effusion of chyle into previously existing cysts. We can well understand how a duct which has a gland behind it might become cystic if it were occluded. Demons reports a case of multilocular cyst in which one compartment contained blood and the other chylous fluid. Kuster described a chyle cyst which was lined with epithelium, a lining which could not have existed in a dilated lymph vessel. Ducasset reports a chylous cyst in which some lobules contained yellowish serous fluid with no evidence of chyle and others contained white chylous fluid. There are a few cases of chylous cysts reported, which had their origin in the dilatation of the receptaculum chyli. Miles Porter states that chyle cysts have various origin, and that nothing is common with them except their contents and location. "Microscopically glandular epithelium will be found in cysts originating in the degeneration of lymph-glands and endothelium in those originating from dilatation of lymph vessels, providing atrophy of these elements has not resulted from pressure." According to Dowd the various forms of chyle cysts are preformed embryonic cysts in which chyle has effused.

*Hydatid Cysts.*—Hydatid mesenteric cysts form a class distinct and separate by themselves, as they are due to a specific cause, the growth of the *Tænia echinococcus*. There are quite a number of cases reported in the literature. The hooklets or the peculiar laminated structures of the cyst walls have been described from the microscopic sections of the cyst.

*Cystic malignant diseases* of the mesentery have been reported, some representing a metastasis from other organs, and several cases primarily occurring between the layers of the mesentery are on record.

*Gas Cysts.*—The gas cysts described by Dr. J. M. T. Finney are really not mesenteric in origin, and cannot be put in our classification.

*Serous Cysts.*—These cases have been referred to by many observers, but the lines of classification are not very well marked, and embryonic cysts such as Dowd's and the ones described below are most likely the serous cysts of the old-fashioned classification.

There are several cases reported in the literature which suggest that the cysts are of embryonic origin from different structures. I. Walker Hall reports a case of a boy, fifteen years old, in whom the cyst consisted of all the layers of the stomach, but it had no connection with the stomach, which was normal as regards position and relation. Fran Van Der Bogert reports a case in a girl, five years old, with the arrangement and structure of the cyst wall similar to that of the intestine. Dowd also mentions a case reported by Eve of a cyst removed from the mesentery of the jejunum, which had three layers of unstripped muscle-fibres within its wall; another by Fehleisen describing a multilocular cyst whose wall contained three layers, an outer connective tissue, and an internal layer of exclusively unstripped muscle-fibre; and another by Bretano of a mesenteric cyst in the walls of which smooth muscle-fibres were found under the serosa. These cases naturally make one think that they are due to a sequestrum of a portion of the bowel.

It is very interesting to note that, besides the connective tissue, fat, lymphatic vessels, glands, and blood-vessels lying between the mesentery, a few fibres from the muscle of Treitz and some of the radiating muscle-fibres of Rouget derived from the two pillars of the diaphragm are present, as well as certain congenital remnants of the Müllerian and Wolffian ducts and bodies.

## SYMPTOMATOLOGY AND DIAGNOSIS.

The most important symptoms of mesenteric cysts are: an abdominal tumor, frequently located centrally, freely movable, and in the female not connected with the ovary, fluctuation of the mass being frequently elicited; obstinate constipation of increasing intensity; severe abdominal pain, relieved by defecation; and a continual abdominal discomfort. Volvulus occurs frequently from twisting of the growth upon itself, thus kinking the bowel. Vomiting is very important, being frequently the symptom of a partial obstruction. Emaciation is often present, but this is not necessarily due to interference with the lacteals, inasmuch as cases are on record in which large portions of the small bowel have been removed without disturbance of nutrition. Emaciation is probably due to constipation and pain. Age is of no significance, cases having been reported varying in age from eleven weeks to eighty years. Mesenteric cysts are more common in women than in men. Puny development is characteristic in these growths.

The cardinal symptoms are therefore as follows: pain, constipation, fluctuating movable mass in region of the umbilicus, and loss of weight. Some growths, however, especially the smaller ones, present no symptoms whatsoever.

## TREATMENT.

No specific rule can be laid down as regards treatment, each case necessarily having to be treated differently, varying on the location and size of the growth and the condition of the patient. Surely every diagnosed case should be operated upon. If the cyst has a definite pedicle it should be ligated and the growth removed, but if there is no pedicle the cyst should be enucleated. If the growth involves the mesentery in such a manner that the involved portion is very broad and its whole width from bowel margin to the posterior abdominal connection is involved, a resection should be performed, as enucleation would possibly disturb the blood supply of the bowels. The method of resection would depend upon the

judgment of the surgeon. Some cysts are so large and so situated that enucleation or resection is out of the question. In these cases an incision should be made into the growth, and drains inserted. These patients drain from four to twelve weeks, but the fistula will finally close.

The most serious complication of these cysts if not operated upon is intestinal obstruction. A number of cases are reported in the literature from this cause. As the growths increase in size, pressure is brought to bear upon the involved bowel centrally and laterally by the lateral growth of the cyst. This central pressure and lateral tension flatten out the bowel so completely that it is with difficulty that anything can pass through it. Volvulus is also an important cause of obstruction in these cases.

In conclusion, we wish to extend our sincere appreciation to Dr. B. M. Edlavitch for his helpfulness in the pathological portion of this work.

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# TRANSACTIONS

OF THE

## PHILADELPHIA ACADEMY OF SURGERY.

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*Stated Meeting, Held March 6, 1911.*

The President, DR. ROBERT G. LECONTE, in the Chair.

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DR. ASTLEY P. C. ASHHURST presented four patients, three from the service of Dr. Chas. H. Frazier in the Episcopal Hospital, and one from the service of Dr. R. H. Harte in the Orthopædic Hospital.

### I. AMPUTATION OF LEG BY THE METHOD OF BUNGE.

By the usual methods of amputation, in which no attempt is made to secure an end-bearing stump, the patient is compelled to wear an artificial leg with an inner socket, and to bear his weight almost entirely on the tuberosities of the tibia. This results in a certain amount of *give* at each step, producing decided disability from a lack of elasticity in the gait, even if there is no marked limp. To overcome this disability, and to secure a stump on which the patient can bear his entire weight as he does normally on his foot, Bier (*Deutsch. Zeit. f. Chir.*, 1892, xxxiv, 436; *Arch. f. klin. Chir.*, 1895, I, 356) devised his osteoplastic method, analogous to that of Pirogoff at the ankle, or of Stokes and Gritti at the knee. Bier's method appears to have been practiced by various surgeons in this country, and has found its way into many text-books of operative surgery; but the much simpler method of Bunge, of Königsberg, seems to be little known. This method was described at length in 1905 (*Beit. z. klin. Chir.*, 1905, xlvii, 808), when the histories of twelve patients were reported. It was proposed on the theory that the tenderness of stump is due to little islets of new formed bone, derived from shreds of periosteum or from marrow cells displaced at the time of operation. Bunge argued that if those could be prevented from developing, and if the bones were to be covered only by a flap of skin, conditions

closely approaching the physiological would be present. Accordingly, his proposition involved not only discarding the periosteal flap, but even sawing the bones 2 mm. below the level at which the periosteum was divided, and then scraping out the medulla of the bones for several millimetres above the level of section. This method was used by Dr. Ashhurst in the case of Edward S., aged forty-seven years, who was admitted Nov. 25, 1910, to the service of Dr. Frazier, in the Episcopal Hospital, for crush of the right foot. Amputation was done five hours later, as soon as the moderate shock present on admission had passed off.

An Esmarch band was applied above the knee; long anterior and a short posterior skin flaps were formed, in the lower third of the leg. The muscles were divided circularly down to the bones at the base of the skin flaps. The periosteum was divided circularly at the same level. Then the periosteum and muscles *below* the section were dissected with most meticulous neatness from the shafts of tibia and fibula, thus absolutely denuding these bones of all tissue for a distance of an inch or more below the level at which the muscles and periosteum had been divided circularly. Then the bones were sawed about one-eighth of an inch *below* the line of section of periosteum and muscle, the fibula being sawed off first, and a little higher than the tibia. Then the medulla of both tibia and fibula was scraped out with Volkmann's sharp spoon for about an eighth of an inch. After ligating the vessels, the Esmarch band was removed, and the skin flaps closed with interrupted silkworm gut sutures, a small rubber drain tube emerging at the outer angle of the incision. This tube was removed on the third day, November 28, without disturbing the deep dressing.

November 30: Light tapping on the end of the stump gave no pain. This tapping was gradually increased in force at each daily visit, never causing any pain; the patient merely acknowledged that he felt it, even when the tapping had increased to a severe thumping with the heel of the surgeon's hand.

December 5: First dressing. Sutures removed. Incision completely healed.

December 10: Patient can now bear without any discomfort all the pressure which can be brought to bear by the surgeon's hand directly on the face of the stump, through thin gauze dressings, so long as this pressure is not suddenly applied.

December 16: Three weeks since amputation. Can stand momentarily on stump, without pain, and with only slight support to hands to maintain balance, and with good leg swinging free of the floor.

December 20: Twenty-five days after amputation the patient was photographed standing on a chair on his stump, balancing himself with his hands on the back of the chair, and his other leg hanging free in the air.

The subsequent conduct of the patient was discouraging. He was discharged from the Episcopal Hospital with directions to apply to the Orthopædic Hospital, where, in the service of Dr. G. G. Davis, it was proposed to have him provided with an artificial leg made to permit use of his end-bearing stump. Within two days, however, of his discharge from the Episcopal, he ordered from another source an ordinary type of artificial leg, with all the weight borne through an inner socket taking its bearing on the head of the tibia; and he merely came to the Orthopædic Hospital to inform his surgeon that the man who made his artificial leg told him that an end-bearing stump was a surgical impossibility; and even though this leg maker had ocular evidence to the contrary, because the patient showed him how he could stand on the end of his stump, yet the leg maker argued that as he had never seen any other stump which could bear the patient's weight, he could not make any other kind of artificial leg than he was in the habit of making.

## II. CONGENITAL ELEVATION OF LEFT SCAPULA.

John S., now aged three and a half years, was admitted to Dr. Harte's service at the Orthopædic Hospital Oct. 1, 1908, at the age of 17 months. He was so weakly at this time that it was thought unwise to institute any very active treatment for the deformity, which was very marked. The child could not sit up, but doubled up constantly to the left side. A year later, Oct. 7, 1909, he was admitted to the ward, and kept in bed with head and foot extension for two months, and was discharged Dec. 20, 1909, wearing a scoliosis brace, with head support, and with noticeable improvement in his deformity. He was readmitted for operation when three years old Aug. 4, 1910.

*Examination* (Aug. 4, 1910).—Head falls to left shoulder, and cannot be brought straight. There is scoliosis, convex to



FIG. 1.



Congenital elevation of left scapula, before operation.  
(Case II.)

FIG. 2.



Congenital elevation of left scapula, three months after operation. (Case II.)

right in dorsal and to left in lumbar region of spine. Skiagraph shows absence of left fourth rib; left third rib is rudimentary, terminating a short distance from the vertebral column. Left second rib is very prominent at costal cartilage, and bends sharply backward across inner wall of axilla. Several skiagraphs showed no evidence of cervical rib. Left arm is not used properly; supination of forearm is not quite complete; external rotation of humerus is normal in extent. Humerus can be abducted to 90 degrees, and then further elevation is checked by scapula which cannot rotate. Muscles: Pectoralis major, trapezius, and deltoid present; tense band of trapezius runs from occiput to scapula. Left latissimus dorsi apparently is absent. Supra- and infraspinatus present. Left arm can be abducted across patient's back until elbow touches angle of right scapula. Right arm can be abducted across back only until it makes an angle of 10 degrees to left of a sagittal plane passing through right shoulder. Scapulæ: Left scapula is considerably higher than right, which is normal.

## Left Scapula.

From vertebral border to acromion, 7 cm.

## Right Scapula.

From vertebral border to acromion, 6 cm.

Length of vertebral border, 6 cm.      Length of vertebral border, 8 cm.

Scapula extends from 5th cervical to 2d dorsal vertebra.      Scapula extends from 1st dorsal to 6th dorsal vertebra.

Left scapula is rotated in frontal plane so that lower angle is only 1 cm. from vertebral spine and is immovably fixed there. (The above measurements were made through the soft parts of a chubby child, and therefore are only approximations.)

*Operation* (Aug. 8, 1910).—Ether, patient prone. Four-inch incision along vertebral border of left scapula; divided trapezius, which contained dense fibrous band running from occiput to upper border of scapula; divided levator anguli scapulæ; divided both rhomboids close to scapula, and excised a cartilaginous band attaching angle of scapula to spine of vertebra (this at once permitted free rotation of scapula in frontal plane); there then remained a few dense bands uniting subscapularis to thorax near angle of scapula, and

these were divided. The scapula was then depressed as much as possible, and the rhomboids were resutured to the upper angle of scapula, above its spine, thus rotating its lower angle away from the vertebral column. The wound was closed without drainage. No exostoses or cervical ribs were found.

Recovery was prompt, and improvement in the deformity and function of the left arm very marked. The child still wears his scoliosis brace, with head support; and owing to the congenital absence of two ribs it is not likely that he will ever be very straight. But he now holds his head erect, can put his left hand to his head, to the nape of his neck, and to the back of his waist. He seems to be still improving.

### III. EXCISION OF URETHRA, WITH END-TO-END SUTURE.

Frank S., aged nine years, was admitted to Dr. Frazier's service at the Episcopal Hospital Nov. 1, 1909, having passed no urine for ten hours. His bladder was distended above the umbilicus. He gave a history of a fall two months before from a height of 3 or 4 feet, astride an iron bar; this was followed by ecchymosis locally, and temporary passage of blood-clots from the urethra. No further trouble was experienced until three days before admission. On admission a filiform bougie was passed with some difficulty, and by gradual dribbling of urine the bladder was emptied within 24 hours.

Though the filiform remained in place, it never was found possible to pass a Gouley catheter over it. It was therefore decided to operate; and in view of the well-known difficulty of keeping traumatic strictures dilated if they are treated merely by incision, it was determined to excise the strictured portion of the urethra, and to suture the divided ends together; but if this was not possible it was proposed to insert a section of a varicose vein which was removed from another patient about that time and kept in salt solution ready for use.

*Operation* (Nov. 12, 1909).—A median perineal incision two inches long was made through Colles' fascia, exposing the bulb of the urethra. The bulbocavernosus muscles were then cleared by dissection on each side, until the superficial layer of the triangular ligament was bared. The urethra (still unopened) was then carefully dissected free from the corpora cavernosa, dense cicatricial tissue being

encountered close to the urethral canal just in front of the triangular ligament. The urethra was then cut across transversely in front of the strictured area (the filiform remaining in place as a guide), and the distal (bulbous) edges of the urethra were caught in mosquito forceps. The strictured area of the urethra was then dissected up through the superficial layer of the triangular ligament until healthy tissue was reached, when the urethra walls were again divided transversely, and the proximal (membranous) portion of the urethra was similarly caught in mosquito forceps to prevent its retraction. About one-half or three-fourths of an inch of the urethra was excised in all. To permit of approximation of the severed ends, the distal (bulbous) urethra was dissected loose for about an inch. A catheter was next passed into the bladder through the perineal wound, and the filiform bougie was withdrawn. A Mercier catheter was then introduced through the penile urethra into the bladder, and the first catheter withdrawn. The ends of the urethra were then united (first the roof and then the sides) with four interrupted sutures of chromic gut. A small wick of iodoform gauze was placed against the unsutured chink in the floor of the urethra, and the Mercier catheter was left in place, draining the bladder through the penile urethra. The perineal wound was closed around the gauze drain with interrupted sutures of silk-worm gut.

The time of the operation was one hour; owing to the scar tissue and the diminutive size of the parts in a small boy of nine years, it was a rather tedious dissection.

The urine drained well from the penile catheter, but on the fifth day this was found to have prolapsed through the perineal wound, and it was accordingly withdrawn. Thereafter most of the urine passed through the perineal wound, but there was no loss of control. Nine days after operation a No. 14 Fr. steel sound was passed with perfect ease; and this was repeated twice weekly for two or three weeks. Urine ceased to come through the perineum after two weeks, and the perineal wound was entirely healed in four weeks.

During January and February, 1910, Nos. 12, 14, and 16 Fr. steel sounds were passed once weekly; then at intervals of two weeks until April 20, when an interval of six weeks was allowed, until June 1. As Nos. 16 and 18 Fr. passed easily then, an inter-

val of four months was allowed to elapse; and as on October 8, 1910, nearly a year after operation, Nos. 16 and 18 Fr. passed with perfect ease, the patient was discharged. He has had no urinary symptoms since the operation, and to-day seems to be cured of his stricture.

#### IV. OSTEOTOMY OF RADIUS.

James McP., aged fifteen years, was admitted to the service of Dr. Frazier, in the Episcopal Hospital, Dec. 5, 1910, with very marked silver-fork deformity of the right wrist, following an injury received seven weeks previously, from a fall on the outstretched hand. The wrist had been dressed by his family physician for three weeks on a straight palmar splint with the forearm in full pronation. On admission, in addition to the deformity, supination was possible only to the mid-position, and the boy could not make a fist owing to inability to flex the proximal phalanges, though the distal and middle could be well flexed. There was a large bony mass projecting beneath the flexor tendons above the wrist. A skiagraph showed an unreduced epiphyseal separation of the lower end of the radius.

On December 7, the patient was etherized, and attempts were made to correct the deformity without operation, but without success. Osteotomy of the radius therefore was done about half an inch above the epiphyseal line. Most of the deformity then could be corrected, though the epiphysis of course was still in abnormal relation to the diaphysis. The arm was dressed in full supination on a Bond splint, well padded to maintain the desired position.

The progress of the case was uneventful, and four weeks later the patient could make a good fist; after six weeks all functions were perfect, and only very moderate deformity remained.

#### ACTINOMYCOSIS.

Dr. J. CHALMERS DA COSTA presented a patient in an early stage of actinomycosis, or, as he preferred to term it, streptotricosis. Until recently actinomycosis meant disease due to the ray fungus alone. Streptotricosis means a disease of man or animal due to one of the various forms of streptothrix. The manifestations of the disease probably differ in accordance with the forms of causative organism. If organisms of thread form are present

the surgeon can be reasonably sure of the diagnosis. If the threads are branched he can be certain of it. The ray fungus is seldom found in humans and is not invariably found in bovine streptotricosis. The appearance of the disease varies with the stage in which it is seen. A description of the surface appearance of an early stage would by no means fit a well-developed or an advanced case. The appearance is greatly changed by mixed infection with pyogenic bacteria. A severe secondary pyogenic infection may obliterate all appearances suggestive of streptotricosis, and in such a case it may be impossible to demonstrate the streptothrix. Certain persistent abscesses, particularly abscesses connected with the alimentary tract, are due to streptothrix infection and secondary infection with pyogenic bacteria.

Every now and then a surgeon sees a long persisting sinus heal under the administration of iodide of potassium. This event at least suggests that the original cause of the condition was streptothrix infection.

The patient was a man, sixty-two years of age, a native of New Jersey and a resident of that State. Until six weeks ago he was entirely well except for two carious teeth in the left upper jaw. There were no symptoms of antral disease. The teeth were pulled. An area of moderate tenderness developed under the orbit, accompanied by purple red discoloration of the skin. This discoloration spread over the left side of the face, little points formed which contained no "matter," and the lower eyelid became œdematous. The speaker lectured on this man before his class at the Jefferson Hospital and presented him as a case of streptotricosis. This diagnosis was subsequently confirmed by the microscopic findings.

In this patient the stage of sinus formation has not yet been reached. There was no sticky glutinous discharge containing sulphur-yellow granules, in fact there was no discharge at all. The line is irregular and the X-ray pictures which were shown exhibit two foci of disease. There was, in this case, a cutaneous lesion arising secondarily to osseous lesions.

The color of the purple-red area disappeared on pressure, rapidly at the margin, much more slowly at the centre. On the removal of pressure the color rushed back rapidly at the margin and much more slowly at the centre. In other words, there was hyperæmia at the margin and beginning stasis at the centre. The

surface may be described as an irregular area of purplish mottling. Each wave-like irregularity or projection was about one-third the size of the little finger-nail. Over the areas of the disease the surface was soft and tender, but individual nodules were not tender. The skin over the nodules was thin and glistening, as though about to vesicate, but there were no sinuses, and no pus ran out on incision.

If this case were not interfered with it would inevitably go on to sinus formation. Microscopic slides show staphylococci as well as actinomyces, hence sinus formation would be certain to arise. Out of each sinus glutinous purulent material would ooze, and, in a typical case, the material would contain yellow granules. In some cases in which such granules cannot be recognized in the pus they become visible by putting the pus in a test-tube with water and shaking the tube. Then the granules adhere to the side of the tube.

This was the fourth case Dr. Da Costa had seen of human streptotricosis. The first patient was a mattress stuffer, the second a physician, and the third a farmer. The patient shown was a railroad switchman. He had not been in contact with horses or cattle, did not handle hay or straw, and does not go into barns.

In only 10 or 15 per cent. of cases is it possible to trace such a close connection with grains as to make it highly probable that the causative organism was obtained from them.

Dr. JAMES K. YOUNG called attention to a case reported in the American Orthopædic Society Proceedings occurring in a patient of thirty-five years who had actinomycosis of the lumbar vertebra. This began originally in the tonsil, travelled down the backed by a large scapular abscess, and finally involved the vertebra. At the necropsy some of the sections of the vertebræ were removed and given to Dr. Speese for examination. It was at first looked upon as tuberculosis with a mixed infection, but later developments in the skin showed the characteristic yellow-sulphur bodies, and the diagnosis of actinomycosis was confirmed at necropsy.

Dr. CHARLES H. FRAZIER reported a case of actinomycosis in a young man who had been referred to the University Hospital with the diagnosis of acute appendicitis. At the operation two unusual features were observed; a pin was found in the appendix and the whole right iliac fossa was a mass of adhesions and



exudate. The appendix was removed only after a tedious dissection and there was so much oozing that drainage was imperative. The drainage tract showed no signs of healing, but suppurated profusely and persistently. A few months later a metastatic abscess was found in the liver and drained, and upon curetting the pus from this collection Dr. B. A. Thomas discovered the actinomycosis. During the course of the next few months the patient developed two attacks of intestinal obstruction relieved by operation under spinal anæsthesia. Bacterin therapy, large doses of iodide of potash, and Röntgen rays were employed, but all to no effect. Neither the abscess in the right iliac fossa nor that in the liver showed any evidence of resolution. Finally the lungs became involved, and the patient died nine months after his admission to the hospital. There was no autopsy.

Dr. ASTLEY P. C. ASHHURST said there had been under his care in the dispensary of the Episcopal Hospital several years ago, a patient in which he made a tentative diagnosis of actinomycosis from the clinical findings. It was an early case, with not much induration. He sent the patient to the laboratory for an examination of the pus, and although the characteristic sulphur-like particles were found, no fungus could be demonstrated, and the pathologist came to the conclusion that it was a case of atypical multiple sebaceous cyst. Some months later in reading a German textbook on surgery he found the statement that sebaceous cysts of the face occasionally assume an actinomycotic appearance, and had been mistaken for this affection by others.

#### A STUDY OF ACTIVE IMMUNIZATION IN ANIMALS, PARTIALLY AND COMPLETELY THYROIDECTOMIZED

Dr. B. A. THOMAS (by invitation) and Dr. ROBERT H. IVY (by invitation) presented a paper with the above title.

#### PLASTIC RESTORATION OF LOWER LIP.

Dr. ADDINELL HEWSON presented illustrations from a case of epithelioma of the lower lip which was submitted to the use of arsenical paste in the hands of a charlatan. When seen by Dr. Hewson this lip was entirely destroyed, and metastases had taken place in both digastric and both superior carotid triangles, necessitating the removal of the alveolar process of the incisive.

canine and first premolar teeth with the involved periosteum on the facial surface of these alveoli and retaining the periosteum on the lingual surface of the alveoli, and finally the removal of four molar teeth and the closing of the wound by the Grant operation. Both facial arteries were ligated in the procedure, and the vestibular surface of the flap on the left side extended as far back as the entrance of Steno's duct. It is needless to say that this was done as a palliative measure and not with any idea of curing the patient, but to relieve the extensive slobbering which existed. The wound healed rapidly and the man's condition was improved. The use of X-ray, when it was found the recurrences had re-appeared in both sides of the neck, was not beneficial, as marked necrosis in the parts affected appeared.

#### MULTIPLE DIFFUSED METASTASES FOLLOWING BREAST CARCINOMA.

Dr. ADDINELL HEWSON read the history of a widow, sixty years of age, who was admitted to St. Timothy's Hospital, Jan. 12, 1909, on account of a tumor in her left breast. The patient presented the appearance of a fairly healthy woman with a mass 5 and 8.5 cm. in size, showing signs of skin involvement and about to ulcerate, in the cephalomedian quadrant of the left breast. The necrotic area measured 3 by 2.5 cm. The arteries and veins were prominent in the skin. A small nodule was felt in the left breast beyond the tumor towards the axilla over the course of the long thoracic artery. There was no supra-clavicular involvement; the nipple was retracted in the line of the cephalomedian quadrant, and the area towards the ventral axillary fold was flattened.

On Jan. 30, 1909, a Jabez Jackson operation was performed, removing the breast, both pectoral muscles, and cleaning out the axilla. The connection between the retraction of the nipple and the growth was shown in photograph of the gross specimen (Fig. 3) taken Jan. 31, 1909, immediately after removal. The wound was entirely healed on Feb. 19, 1909, and the patient was discharged to the dispensary for X-ray treatment. X-ray was applied tri-weekly until Oct. 8, 1909, in all seventy-three exposures, on which date the patient reported a small movable nodule about the size of a pea mezial to the mezial line of union, which was hard, movable, elevated, red but not sensitive; was slightly sen-

FIG. 3.



Carcinoma. Section at operation of breast (L).

FIG. 4.



Rib and femur. Longitudinal section.

sitive in the mezial and lateral lines of union. There were no axillary or supraclavicular enlargements palpable. On Oct. 18, 1909, this tumor was removed. On March 8, 1910, the patient, having had in the interval twenty-two X-ray treatments, reported that after a cold her right arm was swollen down to the wrist, and on examination exhibited a small moderately hard tumor about the size of a walnut in the right midaxillary region which was movable. Patient was advised to have this removed but begged off.

On March 11, 1910, an incision was made over this tumor and the mass enucleated together with the axillary fat, which was submitted to Dr. Swan, the pathologist, for macroscopic and microscopic examination. The diagnosis of soft carcinoma was returned and a Jabez Jackson operation was proceeded with cleaning out the intra-clavicular and axillary spaces. The wound was entirely healed and patient was discharged to the dispensary on April 14, 1910, up to which time the patient had had X-ray alternating each breast seventeen times.

On May 19, 1910, a small nodule showing a tendency to ulcerate at the right extremity of the second operation was noticed and also in the flap of the third operation, *i.e.*, right breast, there was an ulcer about the size of a lima bean with a hardened base but movable on the chest wall, but nevertheless nearer the median line than the ventral axillary fold. The patient was admitted at her request on May 23, 1910, and the fourth operation was performed which enucleated these recurrences.

On May 25, 1910, patient called attention to a hard tumor on dorsal surface of the alveolus of the left first bicuspid tooth. This tumor was fixed, slightly painful, but not inflamed. Patient stated that it had been there ever since the last breast had been removed.

In view of the frequent recurrences it was decided to try a carcinomatous vaccine as prepared by Dr. Coca at H. K. Mulford's laboratory. On May 29, 1910, 12 c.c. of a No. 30 stock solution was introduced into the cellular tissue of both recti abdomini muscles on a level with the umbilicus and over the right external oblique. Patient complained very slightly of pain. There were 24 c.c. in the injections used. On May 30 no complaint from the patient from the injections used. May 31, 1910, all stitches were removed and the wound found entirely healed.

There was, however, some slight induration in the cellular tissue over the right rectus muscle as a result of the injection used two days previous. There was nothing however palpable or visible of either of the other injected areas. Sterile dressings were applied over each; the patient was very sensitive about touching the parts and inclined to be fretful. She was discharged to the dispensary on June 9, 1910. Patient was readmitted to the house on June 23 on account of the extreme pain in the back and right side, which was worse on motion. She was given an antirheumatic and reported three days later as free from pain.

Patient was discharged to the dispensary on July 1, 1910.

July 7, 1910, patient reported as having a great deal of pain on the left side dorsally, pain extends to the left of the spine ventrad to the scapulæ and running around to the ventral aspect of the chest. On physical examination there was an area of dulness to the left of the thoracic spine running laterally 5 or 6 inches and starting about on a level with cephal margin of the scapulæ, continuing caudad for a distance of about 10 inches. In this area there was increased vocal resonance, increased tactile fremitus, and bronchial breathing; she was very nervous.

Patient was admitted to the house July 8, 1910.

Sept. 4, 1910, while the nurse was bathing her she noticed a swelling in the middle of the left femur. The leg gave the patient much pain on motion. On examination it was found that the femur was fractured and that there was overlapping with a shortening of  $2\frac{1}{2}$  inches. The foot was considerably inverted. Buck's extension with 8 lbs. in weight was applied. This was later supplemented by a Physic splint.

Sept. 10, 1910, patient had been fairly comfortable and the extension had relaxed the tension of the muscle about the fracture, but in the meantime a bed-sore had appeared over the sacrum. Patient had involuntary discharges of urine and fæces.

Sept. 14, 1910: While changing the bed a deformity of the right femur was noticed, and upon investigating it was found that the right femur was spontaneously fractured 4 inches below (pedad) the trochanter. Patient was examined by three physicians and diagnosis confirmed. Patient gradually became weaker and died on Sept. 24, 1910, at 11.40 P.M.

*Post-Mortem Report.*—Both mammary glands have been removed, the operation having extended into each axilla. Over the sacrum was a large

excavating bed sore 20 cm. in diameter, with a thick, gangrenous, foul-smelling sloughing mass within it. The left femur was fractured about its middle. Right femur was fractured 4 inches below the greater trochanter. An incision was made on the external surface of the thigh through the intermuscular septum, the femur was sawed through above and below the fracture, and the specimen was removed—this on the left side. The specimen was cut longitudinally, and there was displayed a mass of tissue at the line of fracture about 3 cm. long and 2 cm. wide, the long diameter lying vertically (Fig. 4). There was some attempt at union in the fracture, there having been laid down scar tissue to such an extent as to mask crepitus. The marrow was red about 3 cm. either side of the line of fracture. Beyond this in either direction the color was normal. For about the same distance either side of the fracture the medulla of the bone was rarefied. An incision was made through the right hip and the head of the femur was disjoined from the acetabulum. The upper portion of the bone was removed to within 4 inches below the line of fracture. At this point there was a deposition of new tissue, dense and white in character, invading the medulla and marrow cavity. This measured about 2 cm. in diameter. Here, likewise, the marrow was red either side of the fracture but beyond this was normal. Both axillae were opened. In the left was found a small flabby gland 1 cm. and 6 cm. thick. Nothing found in right axilla.

**Liver:** The common duct was patulous and no enlargement of the glands in this region or within the lesser sack of the peritoneum. The left lobe of the liver on its inferior surface was studded with white dense nodules varying in size from 2 to 8 mm. in diameter and sharply outlined, also slightly elevated. About 30 were present. On the superior surface of the left lobe were about 10 such nodules and about 6 on the spigelian lobe. Only 3 were seen on the inferior surface of the right lobe. About these nodules the liver substance was fatty degenerated, being yellowish in color. Aside from these last mentioned areas, general color of the organ was quite normal. On gross section only three small nodules were found within the right lobe, but the left and spigellian lobes were fairly well occupied by this new tissue. No enlargement of glands in the gastro-hepatic omentum or in the gastric splenic omentum. Stomach contained about 300 c.c. of brownish black material liquid in character. Very little post-mortem digestion had taken place in the mucosa. There was no evidence of old or recent ulceration. Stomach was dilated about one-half. Spleen was normal in size, slate gray in appearance, surface was shriveled, cut with increased resistance, scraped surface bled freely, and there was a slight excess of connective tissue in the trabeculae. No foreign growth present. Pancreas reached from the spleen well over into the curve of the second portion of the duodenum. It was quite normal in appearance, but felt slightly hardened.

**Chest:** Heart reached from the second to the fifth interspace in the midclavicular line. Lungs were darkly pigmented. Both lungs were adherent, apices both showed partial solidification, in this region and throughout the substance of each there were old dense calcareous nodules. In the

lower lobe of both lungs were several masses, which on pressure exuded from their cut surface caseated material. Specimens were taken from these areas.

Ribs and Vertebrae: The fifth, sixth, seventh and eighth ribs on the left side showed small masses or nodules about 4 mm. in diameter on their anterior surface immediately underneath the periosteum and about 10 cm. from the vertebra. The sixth and seventh ribs were fractured at about this distance from the vertebra. Some of these nodules were soft, and when cut exuded a white pus-like material, and in their neighborhood the rib could easily be cut through with a knife. On the right side the fifth, sixth, seventh, eighth, and ninth ribs had these nodules at about the same location as on the left and similar in size and consistency. Sixth, seventh, and eighth ribs were fractured. There were no masses in the intercostal spaces. Chiseling under the vertebra revealed no foreign growth.

#### A STUDY OF CARCINOMA MASTITOIDES.

Dr. EDWARD A. SCHUMANN (by invitation) read a paper with the above title, for which see page 69.



## BOOK REVIEWS.

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PRACTICE OF SURGERY, By JAMES GREGORY MUMFORD, M.D. Octavo, 1015 pages. Philadelphia, W. B. Saunders & Co., 1910.

This book departs from the ordinary methods of surgical textbooks. It is more a series of talks on surgery than an attempt to present in systematic and didactic way the facts of surgery. What the author has to say he has put in a direct personal form; he has a concise way of putting things, bringing to the front the more important matters, with a result that is clear and instructive, and that bespeaks experience and trained observation. There is a certain atmosphere of what might be called surgical common sense conspicuous throughout the book which is decidedly refreshing. No attempt to set forth what might be called the principles of surgery has been made; the writer begins at once with the individual surgical diseases, and in accordance with his plan to take them up in the order of their interest and importance and frequency, so as to preserve a certain surgical perspective, he begins with appendicitis, and goes on from this to a consideration in their sequence of other derangements within the abdomen. Indeed, the table of contents in this book is an interesting commentary upon surgical conditions at the present time. First part covers the abdomen; then the female organs of generation; third the genito-urinary organs, especially the male; then comes the chest, the face and neck, the head and spine; then a chapter on minor surgery, after which a certain series of diseases of structure are considered, including tumors and fractures and dislocations. It will be seen at once from the prominence given in this work to the female organs of generation that Dr. Mumford does not acknowledge that gynæcology is not a part of general surgery.

It seems rather odd to a surgeon who was trained thirty or more years ago to read in a "Practice of Surgery" that, "It does not seem necessary to describe at length the various operations of perineal lithotomy" (page 404). This is precisely true, however, for it is an operation which has quite given way to the suprapubic approach in cases in which the removal by some crushing

process is not deemed best. There is no occasion to go into detailed examination of the various paragraphs of the book. From the text much is omitted which might have appeared. Its chief value is that it sets forth in so interesting a manner surgery as practised by Mumford himself. It is full of practical points, and no surgeon, whatever his experience, can turn its pages without finding something in it of practical value. LEWIS S. PILCHER.

THE DISEASES OF CHILDHOOD AND INFANCY. By HENRY KOPLIK, M.D., Attending Physician to the Mount Sinai Hospital. Third edition, revised and enlarged. Lea & Febiger, New York and Philadelphia. 1910.

The advance in the study of pediatrics during the past three years has been so marked that the author has found that not only was a revision of certain chapters necessary, but the introduction of entirely new matter was essential. The wide clinical experience of the author and the keen insight he has shown heretofore in the consideration of this subject are further demonstrated in this revision of his former work. The author has done all that was possible to make it thoroughly representative of the best and latest knowledge in its particular field. Some 200 pages have been added.

The keystone of any treatise of this class is naturally the problem of infant feeding. The mathematical basis which is used so widely at present is clearly and definitely set forth, and many indefinite points noted in this connection in the former edition have been made clear. We note that while the whey modifications are seemingly appreciated, exception may be taken to the difficulty mentioned by the author in its preparation, and its use is counselled against on this account.

The improvement in the chapters dealing with the diagnosis of the infectious diseases and the technic of their treatment is to be noted. Amplifications have been made to the sections considering diseases of the stomach and those of the nervous system, notably cerebral palsy, encephalitis, poliomyelitis, tetany, and amaurotic idiocy; revision of the chapters on cystitis and pyelitis has also been necessary.

New matter under the head of dwarfism and idiocy has been added. The superficiality of this consideration of infantile psychi-

atry shows the very meagre amount of knowledge we have on the subject, and hardly deserves a separate chapter as yet.

The descriptions of the various diseases and conditions are otherwise clear, definite, and complete, but not long enough to be tiring, and present a satisfactory résumé of the present day science and art of pediatry.

JAMES T. PILCHER.

THE SURGERY OF CHILDHOOD, INCLUDING ORTHOPÆDIC SURGERY.

By DEFORREST WILLARD, A.M., M.D. J. B. Lippincott Co., Philadelphia and London.

In these days of elaborate systems of surgery written by many authors, a treatise like the one before us, written by a single author, is of great value, as it represents the personal experience of many years of active surgical work. The record of the experience is especially valuable when we take into consideration the widely-known surgical qualifications of the author.

The first chapter of the work is directed to the general considerations of the surgery of childhood, which includes some important observations upon the anatomy of infants and children, and especially calls attention to the importance of a thorough and methodical examination of such patients, for the pediatric surgeon must necessarily depend largely upon objective symptoms in these cases upon which to base his conclusions.

The author next considers the various surgical diseases and injuries of infants and children occurring in different regions of the body, and among those especially to be commended is the article upon appendicitis, which he justly states is the most common and important surgical disease of the abdomen in children.

As might be expected from the author's extensive experience with orthopædic cases, the larger portion of the work is devoted to orthopædic surgery, and in the general consideration of this subject the qualifications of the orthopædic surgeon, the use and adjustment of mechanical apparatus and operative technic of this branch of surgery are fully described.

Tuberculous diseases of the bones and joints are fully considered; the comprehensive and practical character of the articles upon tuberculosis of the spine and tuberculosis of the hip-joint render them worthy of careful consideration. The author lays

great stress upon the open-air treatment of such cases, combined with operative and mechanical treatment.

The peculiarities of injuries of the bones and joints in infants and children and epiphyseal separations are fully described, and their diagnosis and treatment is carefully considered.

The chapters devoted to infectious arthritis, acute infectious osteomyelitis, and acute infectious epiphysitis of infants are especially worthy of careful study.

The articles upon tendon transplanting and nerve anastomosis represent the most modern teaching upon these subjects.

The reader cannot fail to be impressed with the very practical character of the article upon the etiology and treatment of the varieties of club-foot.

The work ends with an article upon congenital malformations of the joints and congenital deficiencies of the bones, and the author devotes considerable space to the consideration of congenital dislocations of the hip-joint. After describing the various methods of treatment for the relief of this condition, he states that in the majority of cases he prefers a method which has in his hands been followed by good results, viz., subcutaneous tenotomy of the abductors, the tensor vagina femoris, and the external iliofemoral fascia at the knee ten days before the reduction by the manipulations recommended by Lorenz is employed.

The work is well illustrated, the majority of the illustrations being original photographs. It is noticed that occasionally cuts of adults are introduced to illustrate certain subjects.

The work is eminently practical in character, and represents what is modern in pathology, diagnosis, and treatment, and can be recommended as a safe guide to the surgery of childhood.

HENRY R. WHARTON.

AN ANATOMICAL AND SURGICAL STUDY OF FRACTURES OF THE LOWER END OF THE HUMERUS. By ASTLEY PASTON COOPER ASHHURST, A.B., M.D. Philadelphia, Lea and Febiger, 1910.

This is the Samuel D. Gross prize essay of the Philadelphia Academy of Surgery. The trustees of the Gross fund may feel that they have bestowed the prize for 1910 upon an essay of merit. It has the advantage of dealing with a practical every-day ques-

tion. Most of the patients observed were in the author's services at the Episcopal and the Children's hospitals.

In opening the subject, some of the current teaching is quoted to show the bad prognosis commonly given in elbow fractures. Most of the text-books, the author says, give an unfavorable prognosis, and the quotations from these seem rather more doleful than the common experience in competent hands would warrant. The author is not speaking for himself alone but for modern surgery in general when he says, "With common-sense surgical treatment, the prognosis of any and all fractures involving lower end of the humerus is much less gloomy than it has heretofore been considered, and that in the vast majority of cases the ultimate results will be perfectly satisfactory."

In the author's experience the frequency of fractures is in the following order: Supracondylar, 29; external condyle, 12; epiphyseal separation, 7; internal condyle, 4; epitrochlea, 3; intercondylar, 1. Emphasis is laid upon the fact that, if no portion of the diaphysis is detached, in epiphyseal separation, the line of separation passes directly along the epiphyseal line, and hence will not be visible in a skiagraph.

The most satisfactory chapter is that on the general mechanism by which fractures of the lower end of the humerus are produced. This is a subject not given sufficient attention by teachers and text-books. The rules for examining the patient are admirable. "It is always well to go from the known to the unknown; it is frequently useless to begin by palpating bony prominences around the elbow, since from the extent of the swelling it may be impossible to identify them in this way. Unless some definite method is followed, some important point is nearly sure to be overlooked." Also in the interpretation of radiographs the author displays a large grasp of the subject.

The study of the individual cases is instructive. The treatment is fully described for each form of fracture. Hyperflexion is the position employed by the author in the permanent fixation in all of the fractures described in this book. He recommends hyperflexion warmly for all fractures except the intercondyloid variety.

This method of treatment has been given a pretty thorough test in the hands of many surgeons. It is the feeling of the reviewer that Dr. Ashhurst has permitted his enthusiasm for

hyperflexion to carry him far. Most cases are best treated by this method, but cases are met in which it is distinctly not applicable. The reviewer has seen such cases. Dr. Ashhurst shows such in this book. Case 24 is distinctly such a one. It should not have been put up in extreme flexion. Case 28 is another in which a better result would have been secured, most probably, by other measures.

Studies of series of cases, such as this, with minuteness, constitute the most valuable sort of surgical literature. Dr. Ashhurst has performed a distinct service. J. P. WARBASSE.

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# ANNALS OF SURGERY

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## ORIGINAL MEMOIRS.

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### A CASE OF BILATERAL TEMPOROMAXILLARY ANKYLOSIS WITH AN ORIGINAL METHOD FOR APPROACHING THE TEMPOROMAX- ILLARY ARTICULATION.

BY HOWARD LILIENTHAL, M.D.,

OF NEW YORK,

Visiting Surgeon to Mt. Sinai and to Bellevue Hospitals, etc.

FANNY M., eighteen years old, came to me on December 16, 1905. She was indeed a pitiable object. Eight years before, when a child of ten, she fell, striking violently upon her chin. There was a great deal of pain, not at the chin but in the region of the temporomaxillary joints. From that time the lower jaw ceased to develop and it became impossible to separate the teeth. Three years after the injury an attempt was made to force the jaws with a screw-gag. This was unsuccessful. In order to facilitate the ingestion of fluid, the only form in which food could be taken, the poor girl had had her two upper and two lower incisors extracted. Her face had the characteristic "bird-like" appearance which accompanies temporomaxillary ankylosis dating from childhood.

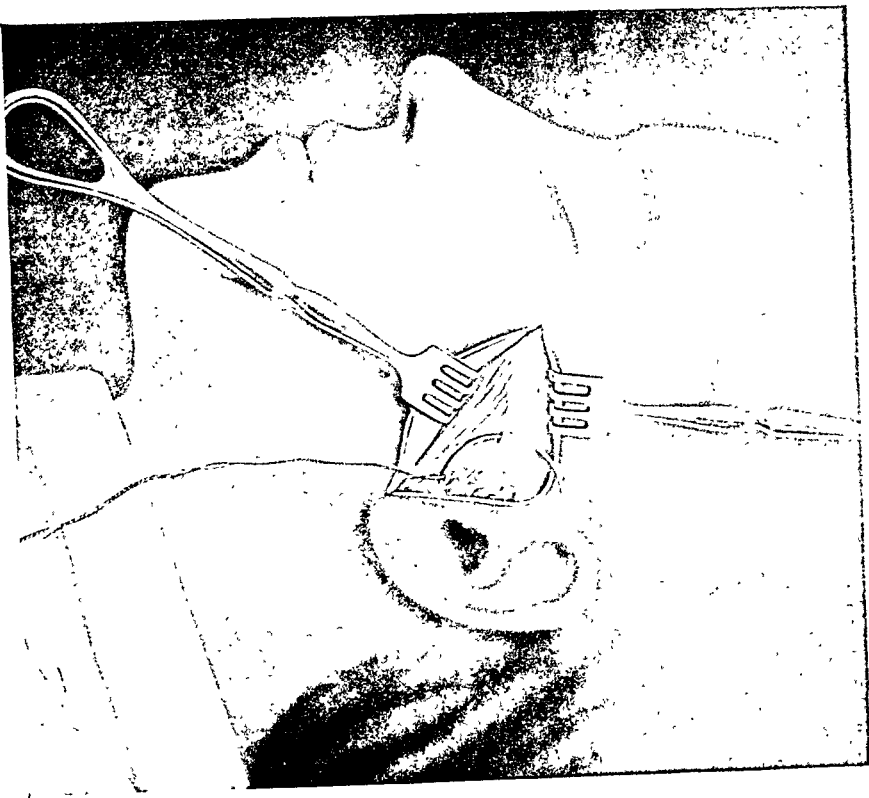
On searching through the literature I was surprised at the number and complexity of operations which had been devised for the relief of this condition, and to note that all appeared formidable, and that there was considerable danger of permanent injury to the branches of the facial nerve. On thinking the problem over it appeared to me that the nerve at any rate need not be injured, and that an easy route of approach might be feasible. A little study with the skull convinced me that the method

which I had devised was worth trying. Accordingly on December 20, I operated upon the left side. Our greatest concern in this case was with the general anæsthesia. It must be remembered that the patient's jaws were absolutely locked, and that in the event of embarrassment of respiration the tongue could not be drawn from the mouth, and should vomiting occur there would probably be great danger of aspiration pneumonia. We therefore prepared our patient most thoroughly with more than the usual time of starvation, and administered a hypodermic of a full dose of morphine a half hour before the operation. Fortunately narcosis was quiet and without accident.

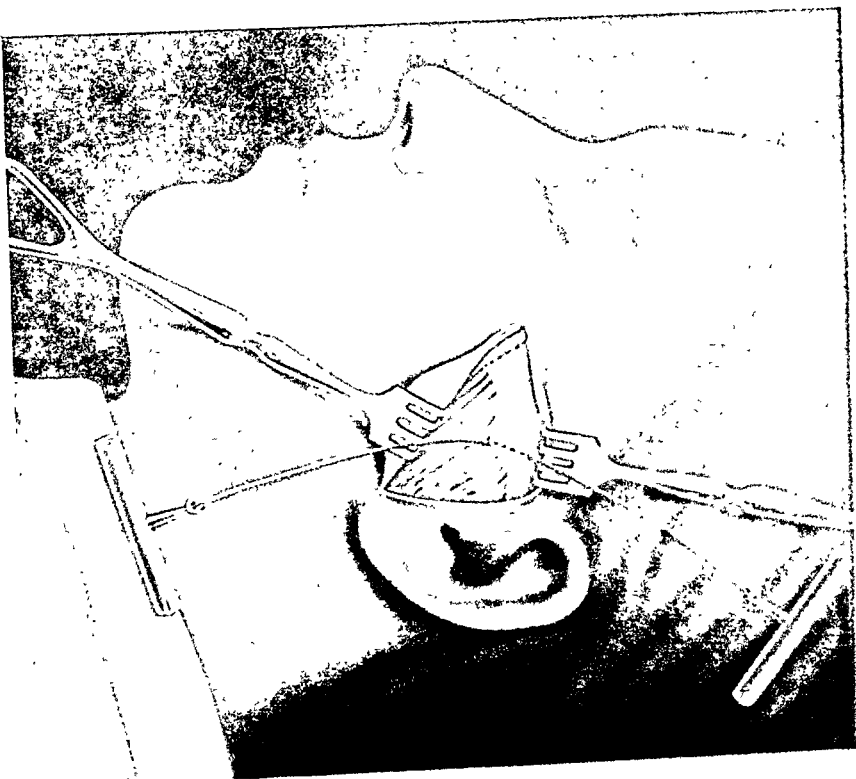
The operation was then performed by the following method: An incision down to the periosteum was made along the zygoma from just in front of the auricle; then from the beginning of this incision, at the point nearest the ear, a second incision was carried through the skin alone, running vertically down for about  $1\frac{1}{2}$  inches toward the angle of the jaw. As stated, this vertical incision divided the skin alone and did not injure any of the subcutaneous structures. The loosened triangular flap was now dissected off and turned downward and forward. A curved hæmostatic needle threaded with coarse silk was inserted just below the posterior portion of the zygoma and passing behind the arch at this point emerged just above it (Fig. 1). A needle similarly threaded was passed in the same manner under the anterior part of the zygoma. A fine Gigli saw was drawn through by means of the posterior thread, and the zygoma with its periosteal covering was divided by a bone section which ran upward and backward. Similarly the anterior portion of the zygoma was divided by a section running upward and forward. The loosened section of zygoma was now drawn downward together with the attached masseter muscle and the other soft parts, carrying with it a part of the parotid gland and fibres of the facial nerve (Fig. 3). This manœuvre exposed the region of the ankylosis perfectly. There was not a vestige of the temporomaxillary articulation. I found a considerable exostosis from the neck of the bone which fused with the surrounding osseous tissue. With a narrow gouge and a strong curette the remains of the distorted condyle and neck were taken away. The ankylosis of the other side, however, prevented more than a slight widening of the oral opening. Laying the osteoplastic flap of the zygoma back in its original posi-



FIG. 1.

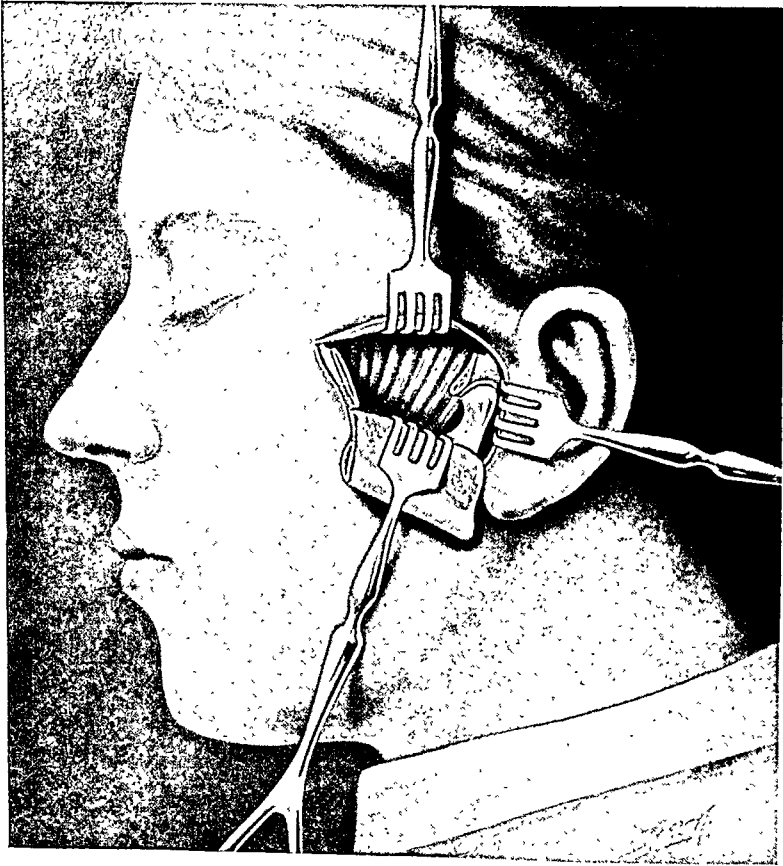


The skin incision, showing also the needle, passed under the zygoma for carrying through the wire saw.



Wire saw in position. The dotted line anteriorly indicates the plane of the second bone section.

FIG. 3.



The zygoma with its attached masseter drawn downward exposing the temporal fossa. The posterior retractor, a blunt one, draws aside the soft parts, nerves, etc., *not* shown in this diagrammatic illustration.

FIG. 4.



The patient, F. M., showing deformity following bilateral fracture of the neck of mandible with ankylosis.

FIG. 5.



Final result of operation, illustrating function.



tion, I found that the normal contraction of the masseter held it in place without wire or other mechanical device, the bevel of the bone sections wedging the loose fragment closely into place. The skin flap was now sutured and the patient sent back to the ward. The entire procedure had consumed less than a half hour.

Nine days later the patient was again anæsthetized and a similar operation performed still more easily on the right side, when there was immediate unlocking of the jaw. There was primary union on the right side and immediate union on the left, but later a slight suppuration occurred here which in some way was connected with the left ear, the drum of which perforated and discharged pus. At no time, however, was there any alarming symptom. Functional recovery was perfect so that within two or three weeks she could exert sufficient power to eat a raw apple, separating the teeth widely and biting into it in a perfectly normal manner.

In order to prevent the possible recurrence of ankylosis, Dr. P. Fiaschi, who was at the time a member of the house staff of Mt. Sinai Hospital, made an interdental appliance for the patient to wear at night, so that she slept with her mouth wide open. She was discharged January 27, 1906, with a perfect functional result, and for a number of months I kept track of her, noting with satisfaction her freedom from recurrence. Artificial teeth bridged the unsightly gap left by the dental extractions.

This operation appears to me so simple and easy of execution, and the resulting cicatrix so insignificant, that I would recommend it not only in cases like the foregoing, but whenever the temporal or the zygomatic fossa is to be invaded. The temporosphenoidal region could probably also be approached in this way. In my case there was not the slightest evidence of injury to the facial nerve, nor was it necessary to suture the osteoplastic flap into position. The plane of section, while described as upward and backward and upward and forward respectively, also ran in such a direction as to wedge firmly on pressure from without. While it will be seen that sutures are thus unnecessary, still, if for some reason it has not been possible to make section exactly as described, one or two fine chromic gut stitches through periosteum will hold the zygoma where it belongs.

# VARIATIONS IN THE ANATOMY OF THE NASOLACHRYMAL PASSAGES.

BY J. PARSONS SCHAEFFER, M.D.,

OF ITHACA, N. Y.

Assistant Professor of Anatomy in the Cornell University Medical College.

IN the course of a recent investigation of the nasolachrymal passages, my attention was directed to the variations that exist in the gross anatomy of the adult nasolachrymal duct. Since some of these variations have a direct practical bearing, I wish in this communication to briefly refer to them. The detailed study of the embryology, gross anatomy, and variations of these passages will be published in a later paper.

In order to make the several portions of the nasolachrymal passages more comprehensible and to show some of the variations, I herewith present photographs of blotting-paper reconstructions of two adult nasolachrymal passages (Figs. 2, 3, and 4). It must be remembered that the reconstructions represent cavities and are, therefore, casts of the nasolachrymal passages.

The nasolachrymal passages consist of the following parts: (a) the ductus lacrimales (lachrymal canaliculi); (b) the saccus lacrimalis; (c) the ductus nasolacrimalis.

*The Lachrymal Ducts.*—The lachrymal ducts consist of vertical and horizontal portions. These portions are well illustrated in the figures accompanying this article. Note in both reconstructions that the inferior lachrymal duct is longer than the superior duct, but that there is a much greater difference between the two ducts represented in Figs. 2 and 3 than in the two ducts represented in Fig. 4.

The superior lachrymal punctum is almost invariably nearer to the medial palpebral commissure (internal canthus) than is the lower punctum—the distance varying in different individuals. This characteristic, *i.e.*, the lower punctum

farther removed from the medial palpebral commissure, is already indicated in the early embryo (Fig. 1). The positions of the lachrymal puncta on the lachrymal papillæ vary. They are usually placed at the summit of the papillæ, but they are at times located some distance from the summit on the side.

At the junctions of the horizontal and vertical portions of the lachrymal ducts, we find rather marked dilatations, the ampullæ of the ducts. These ampullæ vary in size in different individuals, and in both reconstructions figured in this article the ampulla of the superior duct is somewhat larger than that of the inferior duct.

The horizontal portions of the lachrymal ducts communicate with the lachrymal sac in varying ways: (*a*) the ducts may unite into a short, narrow, common duct and this in turn establish communication between the lachrymal ducts and the lachrymal sac (the usual way of communication); (*b*) the ducts may empty separately into an apparent diverticulum of the lachrymal sac—the superior sinus (Maier) of the lachrymal sac (this diverticulum could, however, be thought of as a wide common duct of the lachrymal ducts); (*c*) the ducts may rarely empty separately into the lachrymal sac, *i.e.*, there is neither a common duct nor a diverticulum from the lachrymal sac.

*The Lachrymal Sac.*—The lachrymal sac varies much in size in different individuals. In many cases it passes imperceptibly into the nasolachrymal duct, and its inferior limit can, therefore, be only arbitrarily determined. In both of the reconstructions, however, the limits of the lachrymal sacs are well established. In Fig. 2 the sac is well isolated from the nasolachrymal duct. Note that a portion of the lachrymal sac projects below the point of communication of the sac with the nasolachrymal duct. In such conditions, it would be difficult to pass a lachrymal probe from the lachrymal sac into the nasolachrymal duct because of the rather devious course of this communication. In the nasolachrymal duct represented in Fig. 4, the point of communication between the sac and the nasolachrymal duct is constricted. The con-

striction is, however, a gradual one, and such a condition of the anatomy is certainly conducive to the easy passage of the lachrymal probe at this point.

There is considerable variation in the extent of the lachrymal sac above the point of entrance of the common lachrymal duct. In some cases the fundus of the sac is approximately at the level of the opening of the common lachrymal duct, *i.e.*, the latter duct opens into the most cephalic point of the sac. In other instances the summit of the lachrymal sac extends from 1 to 8 mm. above the ostium of the united lachrymal ducts.

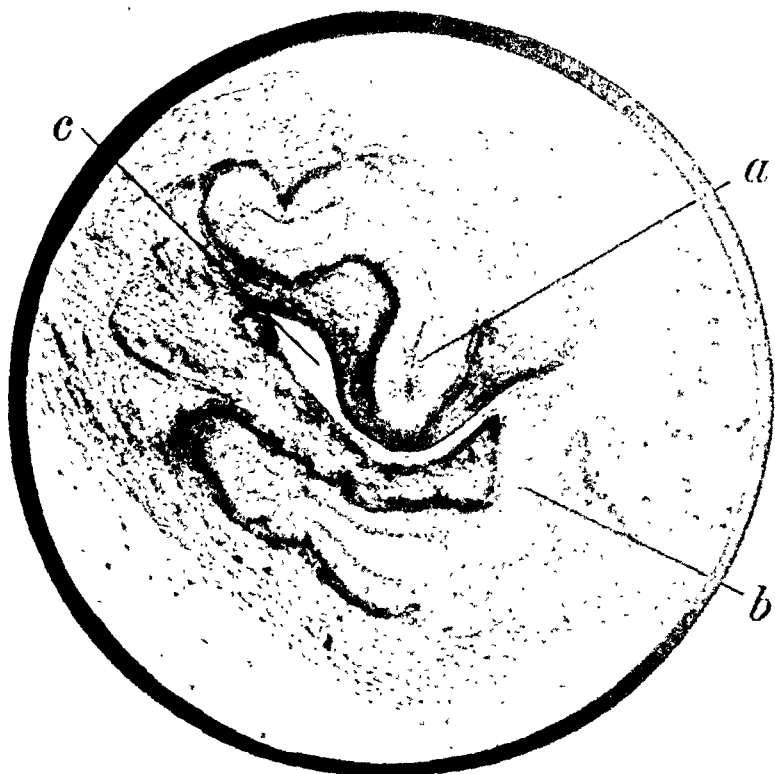
*The Nasolachrymal Duct.*—Of the several portions of the lachrymal passages the nasolachrymal duct presents, according to my investigations, the greatest variations (excluding congenital errors), and it is to this duct that I wish especially to direct attention. For some years I have noticed marked differences in cadavers in the gross anatomy of the nasolachrymal duct. These differences I find are largely due to diverticula of the duct. They occur at any portion of the duct and vary greatly in size and shape.

In Figs. 2 and 3 we have the representation of an adult nasolachrymal duct which is extremely irregular. Note especially the many constrictions and the rather large diverticula from different portions of the duct. Note also the manner of communication between the lachrymal sac and the nasolachrymal duct. The latter communication, the marked constrictions of the nasolachrymal duct at various points, the somewhat tortuous course of the duct, and the comparatively large diverticula from the duct are the points in the gross anatomy of this adult duct that would make the procedure of probing a difficult one. False passages could easily be made and probably often are when such irregularities prevail. These irregular ducts, when infected, would be difficult of treatment, because of the retention of infectious material in the diverticula.

On the other hand, many ducts are quite regular in outline and correspond to the duct generally figured in the textbooks. In Fig. 4 we have the representation of an adult

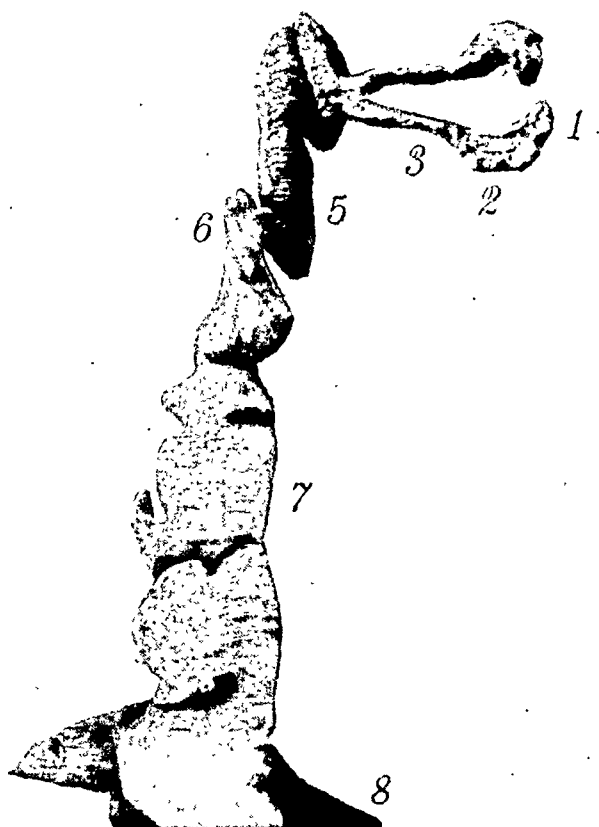


FIG. 1.



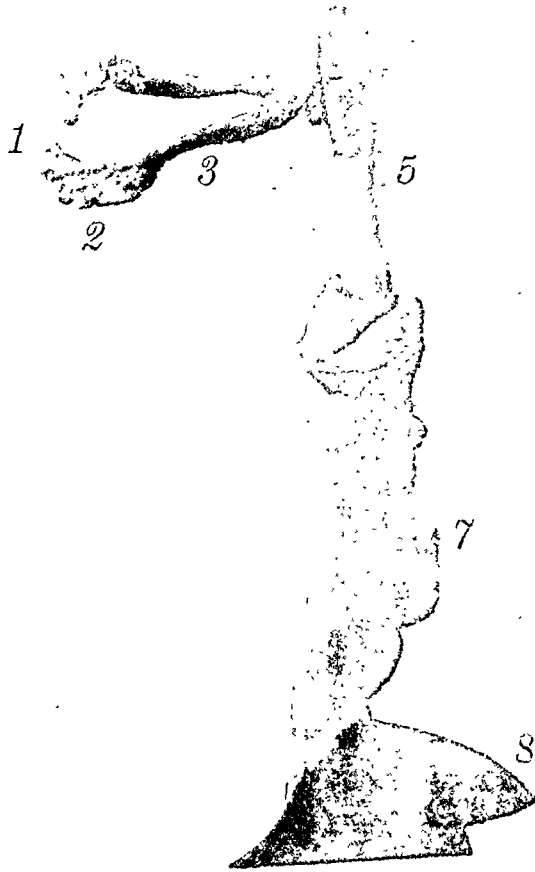
Photomicrograph of a section through the ductus lacrimales (lacrimal canaliculi) from a human embryo aged 120 days (X 31). Note that the ducts have not yet established lumina at all points, but at some places represent solid cords of epithelial cells. Especially note that the inferior lacrimal duct is longer than the superior duct, i.e., the inferior lacrimal punctum is located lateral to the punctum of the superior eyelid. This characteristic is always present in the adult. a, superior lacrimal duct; b, inferior lacrimal duct; c, nasal end of the palpebral fissure.

FIG. 2.



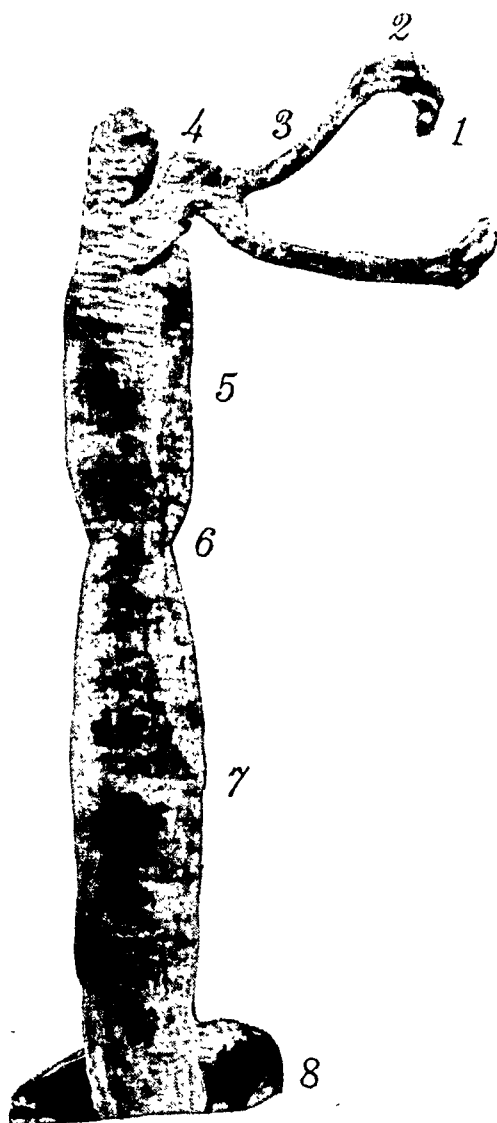
Photograph of a reconstruction of the nasolachrymal passages of an adult female, aged 60 years ( $\times 3.8$ ). Note especially the marked irregularities in the nasolachrymal duct, the rather large diverticula from the duct, and the manner of communication between the lachrymal sac and the nasolachrymal duct. 1, vertical portion of lachrymal duct; 2, ampulla of lachrymal duct; 3, horizontal portion of lachrymal duct; 5, lachrymal sac; 6, point of communication between lachrymal sac and nasolachrymal duct; 7, nasolachrymal duct; 8, portion of the inferior nasal meatus.

FIG. 3.



Another view of the same reconstruction shown in FIG. 2. This figure illustrates the diverticula better. The reference numbers are the same as in FIG. 2.

FIG. 4.



Photograph of a reconstruction of the nasolachrymal passages of an adult male aged 55 (?) years ( $\times 3.8$ ). Compare the regularity of the nasolachrymal duct represented in this figure with the irregularity represented in Figs. 2 and 3. 4, the common lachrymal duct which establishes communication between the lachrymal sac and the lachrymal ducts. The other reference numbers are the same as in Fig. 2.

nasolachrymal duct which presents regular outlines. The junction of the duct with the lachrymal sac is somewhat constricted, but this constriction would offer no obstacle to the passage of the lachrymal probe. The only irregularity of any account is a small diverticulum from the caudal portion of the duct, and this is quite insignificant.

*The Ostium of the Nasolachrymal Duct.*—The ostium of the nasolachrymal duct is, according to my investigations, invariably located on the lateral wall of the inferior nasal meatus. Geddes, however, reports an interesting abnormality in an Irish male subject in which the nasolachrymal duct opened into the middle nasal meatus, a short distance below the hiatus semilunaris. The ostium varies in its location on the lateral wall of the inferior meatus; it also varies greatly in size and shape.

It is located from 15 to 20 mm. dorsal to the limen nasi and from 30 to 38 mm. from the nares (anterior nares). It is frequently found at the most superior part of the inferior meatus, *i.e.*, immediately inferior to the point of attachment of the inferior concha to the lateral nasal wall. On the other hand, the ostium may be located comparatively far inferior to the above mentioned point. The distance varies from 0 to 9 mm. The position of the ostium has a marked effect on the length of the nasolachrymal duct.

The ostium varies greatly in shape. It may be slit-like, the nasolachrymal duct passing more or less obliquely through the nasal mucous membrane. In these cases, the opening is usually guarded by folds of mucous membrane. Occasionally these slit-like ostia are located with difficulty. Pressure on the lachrymal sac usually forces some fluid through the ostium, and in this way it is more readily found. The slit is usually directed vertically, but may assume a more or less horizontal position.

Again we have specimens in which the nasolachrymal duct passes through the mucous membrane rather obliquely, but in which the ostia are not slit-like in character. They are usually more or less overhung by folds of mucous mem-

brane. From the openings, gutter-like channels continue inferiorly for some distance on the lateral nasal wall.

A large number of specimens present ostia that are not guarded by folds of mucous membrane. They present wide, open, unguarded mouths. These ostia are usually found communicating with the inferior meatus immediately inferior to the attached border of the inferior concha, *i.e.*, at the most superior point of the inferior meatus. This type of ostium is readily located and probed with ease—contrasting greatly in this respect with the slit-like ostia and all of those guarded by folds of mucous membrane.

I recently measured a series of ostia and found them to vary from 1 to 6 mm. at their widest point. In many cases the ostium is only a potential opening in that the folds of mucous membrane are collapsed and only open when pressure is made on the lachrymal sac and fluid forced through the ostium into the inferior meatus.

In some instances the nasolachrymal duct communicates with the meatus inferior by two ostia. This anomalous condition is readily explained by the embryology of the duct.

## THE NERVE SUPPLY OF THE ANTERIOR ABDOMINAL WALL AND ITS SURGICAL IMPORTANCE.

BY J. P. HOGUET, M.D.,

OF NEW YORK.

THE anterior abdominal wall is a region attacked by the general surgeon and gynæcologist with such frequency that it would seem as though it should be the most familiar. When we come to consider the situation, however, we find that it is not so. In doing an ordinary laparotomy, the operator goes into the abdomen without giving a thought to the structures through which he is making his way, whether it be through the linea alba, in the right lower quadrant, or through the dorsilumbar muscles. The idea seems to be fairly well fixed that it is best to make incisions between muscle bundles rather than to cut them, and yet how rarely do we see operators going a little out of the way to avoid one of the nerves which courses through the muscles of the abdominal wall. In operating on one of the extremities, there is not any one that would not be watchful in the region of the median nerve in the arm or the anterior crural in the leg. These latter, however, are of no more importance than those that are seen, yet cut in the ordinary right rectus incision for a stone in the gall-bladder or in the dorsilumbar incision for a stone in the kidney. It is questionable whether the importance of the lower thoracic and upper lumbar nerves is fully appreciated by most surgeons, and yet every one of these nerves is, in greater part, a motor one, and though supplying a relatively small amount of muscle tissue, each supplies a certain segment, which, when paralyzed, is perfectly apt to become flaccid enough for the passage of a ventral hernia. This latter is often a greater trial to the patient than the original trouble for which he was operated upon. An abdominal belt or support is rarely of any real benefit. It serves in only a slight measure to alleviate the

mistrust which the patient has in his abdominal muscles, and when this mistrust is increased by the ever-present fear of an intestinal strangulation, life really becomes such a burden that the patient is most insistent on another operation to put him in good condition. When we consider that these ventral hernias are in otherwise perfectly strong men and women, who except for this disability would be able to do heavy physical labor, we can in some measure appreciate the importance of preserving, by a small amount of extra care and time, the few nerves one encounters in doing an ordinary laparotomy.

On the other hand, we know that in certain cases, where there has been a ruthless sectioning of nerves, paralysis of the abdominal wall and subsequent hernia does not follow. In a very thorough treatise on malignant tumors of the testicle, Chevassu of Paris, in the *Revue de Chirurgie*, for May, 1910, describes a radical operation for the removal of the testicle and the secondarily involved lumbar glands, in which an incision is made from the last rib to the crest of the ilium along the edge of the quadratus lumborum, thence parallel and slightly above Poupart's ligament to the scrotum. The muscles are cut, the peritoneum reached, and the glands removed retroperitoneally. It follows, then, that the twelfth dorsal and the first lumbar nerves are cut, and yet, in one case that Chevassu describes, he definitely says that a year after the operation not the slightest trace of a hernia could be found. In direct contradiction to this, is the case whose photograph is given in Fig. 1. This young man was operated upon in April, 1910, for a stone in the left kidney, and was first seen by the author in March, 1911. At that time, he presented an oval swelling, on coughing or straining, immediately outside of the outer border of the left rectus, about the size of a large orange. A definite margin could be made out, but it felt differently than an ordinary post-operative hernia, so that it was immediately apparent that the deficiency was in the muscular tissue, and that the aponeurosis of the external oblique was still intact.

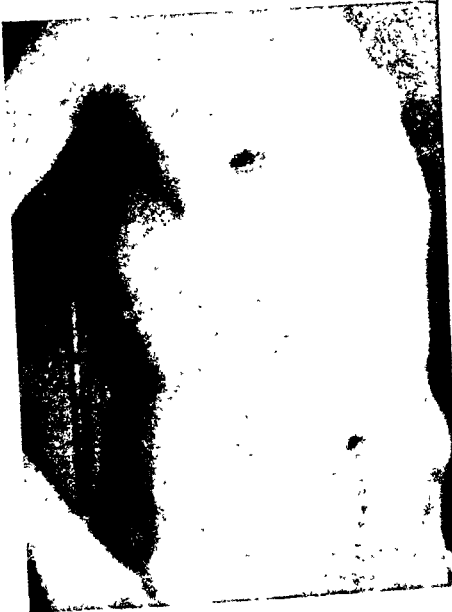


FIG. 1.



Hernia of anterior abdominal wall following section of last dorsal and first lumbar nerves during operation for renal calculus.

FIG. 2.



Same hernia.

FIG. 3.



Same case, showing scar of previous operation on kidney.

Another illustration of this class of "hernia from paralysis," is that fairly often seen, in which a right inguinal hernia appears a short time after an operation for appendicitis through a McBurney incision. These occur more often in pus cases where the wound has been drained. The logical reason for the existence of this kind of hernia, of course, is that, in separating the fibres of the internal oblique and transversalis muscles, the last dorsal and first lumbar nerves were pressed upon and reached, so that they lay at the edge of the wound. It is quite conceivable that these nerves could be killed by the pressure of a fairly stiff drainage tube, or that the pus in the wound started up an inflammatory process in the nerve substance which led to their subsequent atrophy. Granted this, the lower part of the internal oblique and transversalis muscles would be partially paralyzed. Paralyzed muscles atrophy to a varying extent, but if these atrophied at all, there necessarily would be a certain laxity at the internal abdominal ring, which would probably be enough to allow the passage of an inguinal hernia.

Of recent years, especially since the use of a local anæsthetic, the importance of preserving the iliohypogastric branch of the first lumbar nerve has been realized, so that now almost all surgeons are careful not to wound it or include it in the deep sutures, in order that there may be no paralysis of that portion of the internal oblique which it supplies.

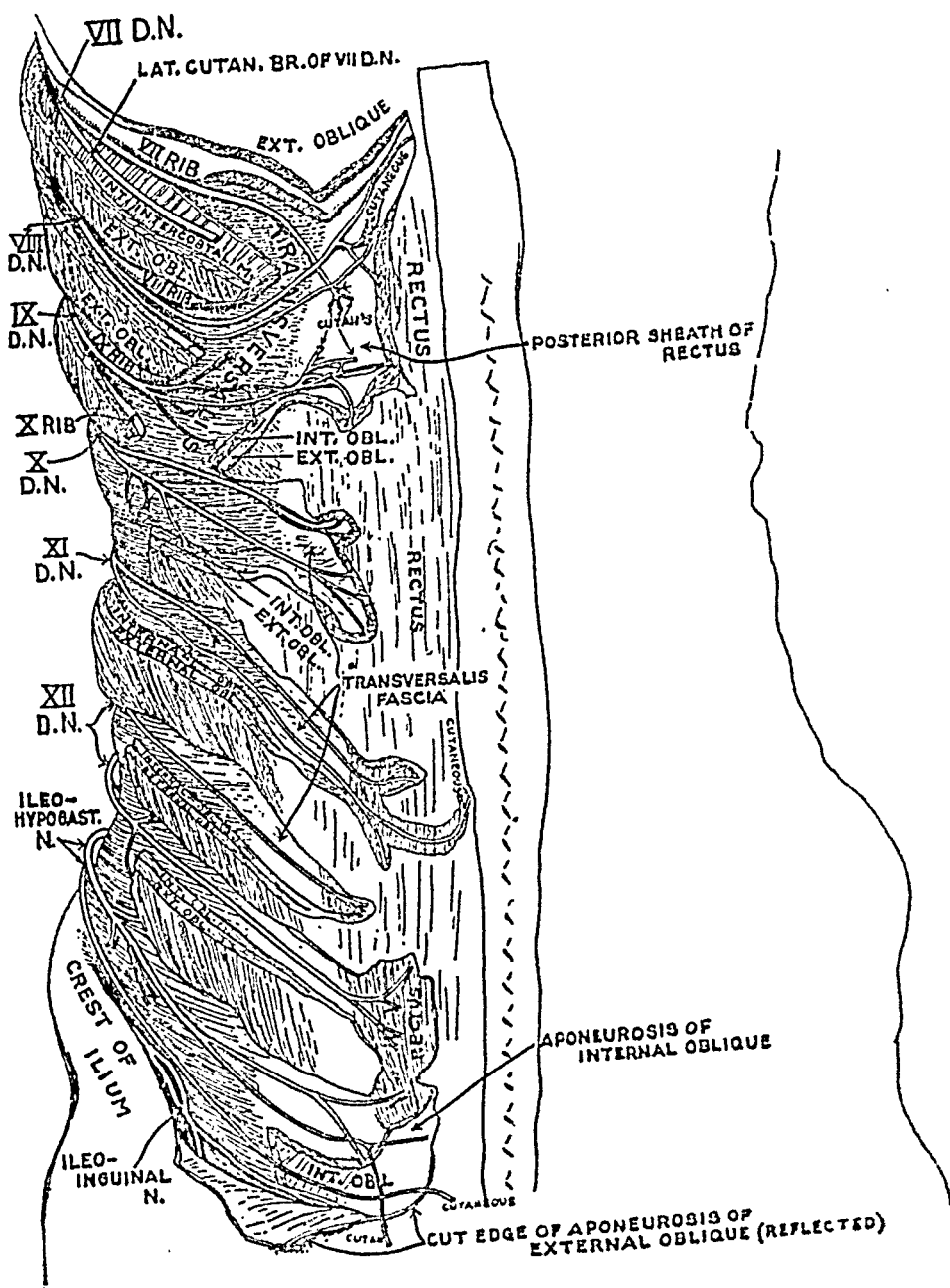
On account of the importance of this subject, the following brief description of the abdominal nerves is given, together with drawings and photographs of some of the dissections which were made by the author in the dissecting room of the Cornell University Medical School. For the privilege of making these and also for his many useful suggestions, the author desires to express his gratitude to Dr. Irving S. Haynes, Professor of Anatomy at the above school.

The nerves under consideration are the anterior divisions of the lower seven dorsal and the first lumbar. The upper dorsal and the lower lumbar are of no interest to us at this

time. The seventh, eighth, ninth, tenth, and eleventh dorsal nerves emerge from below the corresponding vertebra and rib, and lie in the subcostal groove of the corresponding rib below the intercostal artery and vein. At the side of the chest the upper nerves pierce the internal intercostal and lie on the pleura. At the anterior end of the intercostal spaces these nerves pierce the attachment of the diaphragm and the transversalis muscle to the costal cartilages, behind which they pass and run in the abdominal wall between the transversalis and internal oblique muscles. They then pierce the sheath of the rectus, and reach its posterior aspect. They pierce the muscle again, reaching its anterior aspect, and finally become cutaneous over it. Each nerve sends off muscular branches to the muscles which it traverses in its course. After leaving the intercostal spaces, each nerve takes a slightly different course. The seventh, eighth, and ninth nerves turn almost at right angles after leaving the costal arch, the seventh running downward, the eighth and ninth upward in the rectus, and the tenth and eleventh running downward and inward in the same muscle. During their course each nerve gives off motor branches to the intercostals, transversalis, obliqui, and rectus muscles. Besides these, they also give off cutaneous branches, with which we are not especially interested here. Suffice it to say that each nerve gives off a lateral set (*nervus cutaneus lateralis*) which supplies the skin of the loin, and an anterior set which pierces the external intercostals, and, reaching the skin, supplies it from the ensiform to below the umbilicus.

The twelfth dorsal nerve is peculiar in its course and of even more importance, surgically, than the other dorsal nerves, for it can easily be understood in what danger this one is from an ordinary McBurney incision. It leaves below the last dorsal vertebra and last rib, at first behind the psoas muscle and then lies in front of the quadratus lumborum. It pierces the transversalis, and runs between it and the internal oblique in a downward and inward direction to the edge of the rectus, which it pierces, becoming cutaneous over

FIG. 4.



it. It gives off muscular branches to the transversalis, obliqui, recti and pyramidalis muscles. A large lateral, cutaneous branch, commonly known as the iliac, is given off at the side of the abdominal wall, runs downward, becomes superficial over the crest of the ilium about three inches behind the

anterior superior spine, and supplies the skin of the buttock. Beside these branches it also gives off a communicating branch to the eleventh dorsal and one to the first lumbar or its iliohypogastric division.

The first lumbar nerve emerges from below the first lumbar vertebra, and after running a very short distance divides. Its upper division is continued outward in front of the quadratus lumborum, and then pierces the transversalis, as do the dorsal nerves. The lower division helps in the formation of the lumbar plexus, more especially the genitocrural nerve, by joining with the upper division of the second lumbar. The upper division of the first lumbar courses between the transversalis and internal oblique, and divides into two branches, the iliohypogastric and the ilio-inguinal. The former runs about one inch above the crest of the ilium, there giving off its iliac branch, which lies in front of the iliac branch of the twelfth dorsal and about two inches behind the anterior superior spine. The main branch of the iliohypogastric, which is often double, continues downward and inward, roughly parallel to the twelfth dorsal, pierces the internal oblique, and lies about half an inch above the inguinal canal, just under the aponeurosis of the external oblique. It is this nerve that is so often seen in doing the Bassini operation for inguinal hernia, and is not altogether sensory, contrary to the general opinion, as in its course it gives off muscular branches to the transversalis and internal and external oblique muscles. The ilio-inguinal nerve emerges from underneath the internal oblique and transversalis about one inch in front of the anterior superior spine, courses downward and inward just above Poupart's ligament, and behind the aponeurosis of the external oblique, finally coming out through the external abdominal ring with the cord, and ends by becoming cutaneous over the pubes. This nerve gives off several muscular branches in its course. It is the inclusion of this nerve in the deep sutures of a Bassini operation that gives rise to the pain in the wound that we sometimes see after operation.



Lateral view of nerves of abdominal wall.

FIG. 6.



Anterior view showing nerves of entire abdomen.



View from behind, showing emergence of abdominal nerves.





The knowledge of the anatomy of these nerves is of greatest importance to the surgeon in placing an abdominal incision. For instance, a high McBurney incision would reach the twelfth dorsal in some part of its course, while a very low one might reach the iliohypogastric. In a Kammerer incision for an appendix, the eleventh and twelfth dorsal and the iliohypogastric nerves are probably very often injured, this being all the more probable because of the fact that here these nerves lie on the posterior sheath of the rectus, and although the muscular fibres are separated, the sheath is generally cut with a knife. As already illustrated by Fig. 1, the twelfth dorsal and first lumbar nerves are in great danger from the usual incisions made in operations on the kidney.

The question may be asked, why do we not see more herniæ from paralysis, inasmuch as there are so many laparotomies done now? The answer to this is, that the communications between the nerves are fairly numerous, and after section of one, its duties are probably taken up by the nerve that communicates with it. Still we know that this does not always occur, and therefore it is the duty of every surgeon, in making an incision through the abdomen, to exert the utmost precaution to avoid injuring any nerve that he may meet.

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# AN APPARATUS DESIGNED TO FACILITATE PELVIC SURGERY BY APPROXIMATING THE ABDOMINAL WOUND TO THE DEPTH OF THE PELVIS.

By WALTER H. TAYLOR, M.D.,  
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SATISFACTORY retraction of the abdominal wound during hysterectomies or other operative procedures in the deep pelvis of fat subjects is exceedingly difficult, sometimes impossible of attainment. On several occasions I have felt the necessity so keenly of some new light upon this problem, that I have dreamed of its solution, and the object of this communication is to call attention to a device I have employed for the purpose of obviating some of the difficulties I have experienced when operating in the pelvis through thick abdominal walls. Dr. Howard A. Kelly, in the March, 1911, number of the *ANNALS OF SURGERY*, advocates lipectomy or the excision of large oval wedges of skin and fat in these cases, not for the relief of the obesity as recommended by him in a former paper, but simply and solely for getting rid of a part of the thickness of the abdominal wall and making the field of operation more accessible. The device described below could be used in conjunction with lipectomy in certain cases of unusual difficulty. In addition to firm uniform retraction of the wound, the writer claims for this apparatus the following advantages: It approximates to some extent the wound itself to the depth of the pelvis. It disposes the plane of the abdominal opening to lie at right angles to a line from the pelvis. It packs out of sight and of harm's way large masses of adipose tissue, thus producing in a fat abdomen many of the ideal characteristics of a thin one. And lastly, it provides absolute protection to the wound itself during the operation, leaving the surgeon, when all is done, to the ecstatic contemplation of a wound of virgin purity, notwithstanding the presence of infection in the pelvis.

The present form of the instrument consists of the following parts: (1) A large oblong steel ring. This is to be laid

on the patient over the laparotomy sheet before the operation begins. It extends from the ensiform cartilage to the pubes or a little below it, and from flank to flank, being depressed at the flanks toward the table and arched above and below, over the thorax and the pubes. A vertical steel post projects from the centre of its pubic portion. (2) A smaller steel circle, about five inches in diameter, made up of two perfect semicircles, which are brought into apposition within the abdomen to form the circle. The semicircles are inserted one piece at a time, much like the blades of midwifery forceps, by grasping the handles, the end of each semicircle nearest the pubes being welded to a shank or handle. When the circle is completed and in position within the abdomen, these two shanks lie together as one. From the junction point of the inner circle this duplicate handle passes directly upward, through the incision at its pubic angle, and emerging from this angle it then runs outward across the skin of the pubic region, the pubic angle of the wound being engaged in the concavity thus formed. These shanks, of which the duplicate handle is composed, are made to interlock upon the surface and simultaneously the circle is completed within the abdomen by the approximation of the free ends of the two semicircles. The shanks being locked, their free ends are applied to the upright steel post on the pubic portion of the outer ring. By means of a set screw on the free end of one of the shanks both shanks are screwed rigidly together and rigidly connected with the steel post on the outer ring as high or as low as is required (Fig. 1). The third component consists of two broad wings of some strong cloth fabric (Fig. 2). It is by means of these that the actual retraction of the wound margin is effected. The same object might be attained, as the same principle would be involved, by a series of tapes attached at regular intervals to points on the circumference of the inner ring, drawn firmly out of the wound in all directions, and attached to corresponding points upon the outer ring. The two broad wings of cloth, however, are much more easily adjusted and at the same time afford better protection to the wound. Each semicircle is sheathed, as in the figure, by the inner margin of one of these cloth wings before its introduction into the abdominal cavity. When the circle is completed within the abdomen it appears entirely clothed, and from all points of its circumference the fabric passes inward to the inner aspect of the wound, passes through the wound, then flares outward across the skin, to be attached to the outer ring. These

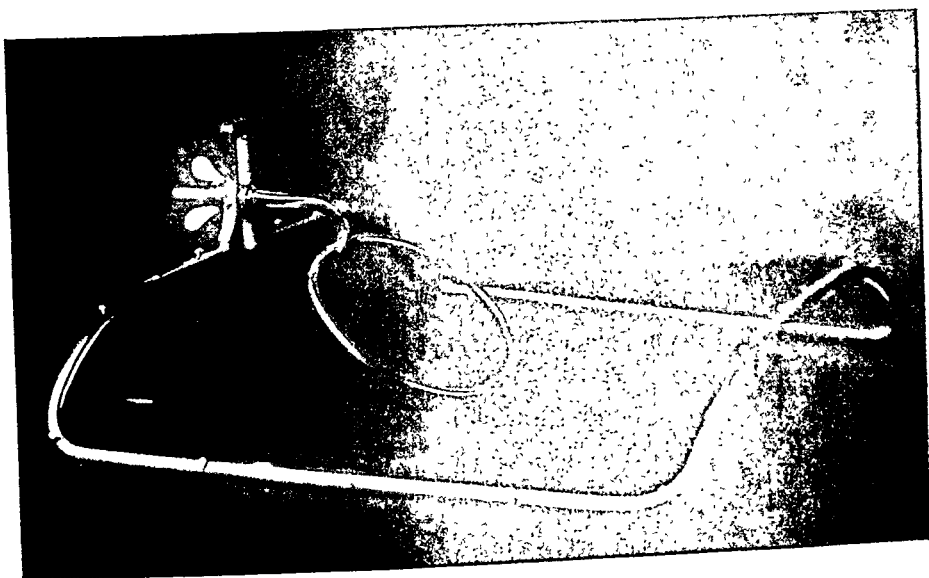
wings overlap each other at their edges, and are reinforced radially by tapes along the lines of traction. They have series of small button-holes extending outward on the tapes which are slipped over rounded steel knobs on the outer ring. A certain amount of radiate reduplication will occur, but the folds lie flat and hard against the wound and skin (Fig. 3). The inner ring lies entirely out of the way beyond the margin of the wound, except where the shanks emerge.

Note the angle at which the inner ring is set (Fig. 1). The effect of this is to keep the pubic region hooded and to cause depression of the remaining area around the wound, thus bringing the wound closer to the depth of the pelvis and disposing its plane to the most accessible angle. It will be seen also why the fat should be flattened out and rolled towards the outskirts. The combined effect of the above considerations will be found very gratifying, as I can testify, when seen in operation. Protection of the wound is a collateral advantage of much importance in these very cases, the bulky and easily devitalized adipose being shielded, not only from bacterial infection but from the reiterated traumatism to which, during the course of long and difficult operations, this tissue is frequently exposed. It is to be observed that the extent of the division of the fat should be in proportion to its thickness, in order that it may be readily displaced. Cleaning the upper surface of the aponeurosis for an inch or so outward on each side tends to loosen the fat from its moorings and thus to facilitate its displacement. Hæmostasis of the incision is provided for during the operation at least, by the pressure exerted in maintaining traction.

The adjustment of this apparatus is not so simple as that of the ordinary self-retaining retractor, but it can be quite readily and quickly accomplished. With the patient in the Trendelenburg position and the sponges placed, introduce one piece with its cloth wing trailing from the wound. Let the lower end of the semicircle rest against the sponges near the posterior abdominal wall and the concavity of its shank engage the pubic angle of the incision. Insert the other piece and lock the shanks, a finger in the abdomen will certify that no bowel is being included. Apply the free end of the shanks to the upright steel post and turn the set screw. The operator and his assistant then spread out the wings and fasten them to the outer ring, drawing gently from opposite sides.

Another feature to be considered as an advantage is the fact

FIG. 1.



Inner and outer rings. Inner ring composed of two semicircles rigidly connected with steel post on outer ring by means of set screw. The cloth wings are not shown.

FIG. 2.



Semicircles with cloth wings attached ready to be inserted into the abdominal cavity.

FIG. 3.



Apparatus complete. Cloth wings making traction from the inner to the outer ring, thus spreading and depressing margin of wound.



that the depressed portion of the inner ring and the fabric which extends from it to the umbilical angle of the incision act as a buttress for the sponges employed in packing away the bowels, thus preventing their encroachment on the operative field. Greater security in infective cases would probably be assured from the fact that the sponges are divided naturally into two sets—the permanent sponges held firmly in place external to the depressed circumference, and the sponges packed lightly in front of these within the lower arc, which can be renewed at will. The Trendelenburg position may be dispensed with if thought advisable.

The model shown in the figure is the second one that I have had made for me. The first one, though made by a blacksmith and very crude, answered the purpose surprisingly well. A modification has lately occurred to me, however, of which I have as yet no model, which will I believe appreciably enhance the usefulness of this instrument. Instead of the inner ring being a perfect circle all the diameters of which are in the same plane, my present suggestion is to have its plane warped so as to produce an anteroposterior concavity looking toward the operator, its convexity toward the pelvis, the angle at which the ring depends from the pubes remaining as in the figure, but sagging now towards the pelvis in happy imitation of the scaphoid lines so characteristic of the emaciated abdomen, to the classic delineaments of which it is our purpose to have obesity conform! The fat which is to be displaced toward the flanks and packed into the right and left inguinal regions can be more readily manoeuvred across these concave steel rami descending from the pubes.

In conclusion I am confident that this instrument needs but to be employed once in a difficult case of pelvic surgery for its value to be appreciated. To those who, like myself, are prone to feel that they at least are ill able to afford to neglect to avail themselves of an added facility, I beg to commend this device. It has proved invaluable to me, and I cannot but believe that it will prove serviceable to others, more particularly in those cases of pelvic surgery in which very thick abdominal walls are the chief cause of difficulty.

# NOTE ON PENETRATING WOUNDS OF THE ABDOMEN. \*

REPORT OF CASES TREATED AT THE MACON, GA., HOSPITAL.

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OF MACON, GEORGIA,  
Gynecologist to the Macon Hospital.

FROM 1905 to 1910 inclusive I was able to collect from the Macon Hospital records 50 cases of penetrating wounds of the abdomen. There was a mortality of 52 per cent. Two cases were not operated on and died; two were incised wounds, both recovered; the remainder were pistol shot wounds. During the past year we had 15 cases which came under my personal observation, and it is these which I wish to report in detail.

	Recovered.	Died.	Total.
1905.....	3	1 (no operation)	4
1906.....	3	5 (1 not operated on)	8
1907.....	5	5	10
1908.....	3 (2 incised)	3	6
1909.....	3	4	6
1910.....	7	8	15
	24—48 per cent.	26—52 per cent.	50

These cases were operated upon by six different surgeons with considerable difference in technic. From experience as well as reference to the literature, we have reached the following conclusions:

1. In all penetrating wounds of the abdomen seen within twelve hours of the injury, operation should be done as promptly as is consistent with good technic and careful, skilful work.
2. The incision should be so made and large enough to

\* Read before the Medical Association of Georgia, April 20, 1911.

insure a thorough survey of the abdominal viscera without unduly exposing them.

# RECOVERIES.

*Cases in 1910.*

Case No.	Age.	Race and sex.	Time between injury and operation.	Number of perforations.	Remarks.
1. ....	4	B.M.	12 hrs.	4	Two perforations in large bowel, 1 in stomach, 1 in liver.
2. ....	17	B.F.	2 hrs.	0	Peritoneum entered tangentially, no viscera injured.
3. ....	25	B.M.	6 hrs.	0	Peritoneum entered tangentially, no viscera injured.
4. ....	21	B.M.	1 hr.	12	12 perforations in small bowel, two in large.
5. ....	18	B.M.	1 hr. 30 min.	14	
6. ....	22	W.M.	1 hr. 30 min.	6	Small clean-cut perforation in small bowel with steel coated ball.
7. ....	35	B.M.	3 hrs.	3	Two perforations in large bowel, one in liver.
Total .....			27	39	
Average .....			3 hrs. 50 min.	5.57	

3. Extensive evisceration is unnecessary and unjustifiable, greatly increasing the mortality.

4. Unless the peritoneum is extensively soiled, intestinal contents should be wiped away with salt gauze sponges, irrigation does more harm than good.

5. If the closure of the perforation or destruction of blood supply threaten seriously the usefulness of a portion of bowel, resection should be done.

6. If the peritoneal cavity be generally or extensively soiled, or if there be any considerable oozing, drainage is safer; otherwise the incision may be closed.

7. Post-operative treatment is very important. If there be no lesions in the large bowel salt solution and coffee, of each 150 c.c., should be given per rectum every four hours. If the large gut be injured, the continuous drop method of Murphy is preferable.

Fowler's position should be maintained, pain controlled and peristalsis diminished with moderate doses of morphia. In

## DEATHS.

Case No.	Age.	Race and sex.	Time between injury and operations.	Number of perforations.	Remarks.
1.....	55	B.M.	12 hrs.	5	Died in 56 hours. of peritonitis.
2.....	35	B.M.	6 hrs.	15	Came in almost moribund; died on table; two perforations in bladder.
3.....	15	B.M.	3 hrs.	15	Came in almost moribund, died on table.
4.....	37	B.M.	7 hrs.	2	Patient improved steadily after operation; died suddenly two and one half days later.
5.....	39	W.M.	12 hrs.	4	Two perforations in large bowel, two in small; died in 18 hours of shock.
6.....	39	B.M.	12 hrs.	15	Died 18 hours later, never rallying from operation.
7.....	19	B.M.	3 hrs.	14	Died in 4 hours of shock.
8.....	25	B.M.	3 hrs.	14	Died in 27 hours of shock.
Total.....			58	84	
Average.....			7 hrs. 15 min.	10.5	

	Recovered.	Died.
Cases operated upon within 2 hours.....	4 (100%)	0
Cases operated upon within 2 to 7 hours.....	2 (28.5%)	5
Cases operated upon within 7 to 12 hours.....	1 (25%)	3
	<u>7</u>	<u>8</u>

injuries to the stomach or small bowel, nothing but small amounts of water should be given by mouth during the first 48 hours. Small quantities of liquids may then be given, care being exercised to avoid distension. This symptom is often troublesome and is best relieved by the rectal tube.

# CONGENITAL HYPERTROPHIC STENOSIS OF THE PYLORUS.\*

BY RUSSELL COOMBE, F.R.C.S. (Eng.),  
OF LONDON, ENGLAND.

With Notes by W. GORDON, M.D. (Camb.), F.R.C.P. (Lond.), and  
J. SHIRLEY STEELE-PERKINS, M.D. (Camb.).

PRELIMINARY NOTE BY DR. W. GORDON.

ON December 14 last I was asked by Dr. Cooper of Lyme Regis to see a baby, six weeks old, which was vomiting almost all its food. The vomiting had begun soon after birth, had been slight at first, but had gradually got worse until almost everything was returned, a feed of more than an ounce being almost certain to be vomited. The vomiting was sudden and moderately forcible. There was constipation; small, sometimes greenish, motions being occasionally passed. At birth the weight had been 10 pounds, now it was only about 8 pounds.

I found the child very thin, but hungry, alert, and looking quite unlike one suffering from severe gastritis. A small feed had just been given. On uncovering the abdomen a slight tumor was visible between the left ribs and the umbilicus and after a sharp flick on the skin in that region, this tumor became more marked, and waves of peristalsis could be seen passing over it from left to right. Careful palpation, however, failed to discover any pyloric thickening, although the abdomen was flaccid and the child amenable, so that examination was unusually easy.

We diagnosed hypertrophic pyloric stenosis and, as careful dieting had failed to prevent rapid loss of weight and strength, we decided only to postpone operation for a few days, during which we tried peptonized milk in very small feeds and gastric lavage with normal saline solution. Meanwhile to minimize the effects of further vomiting, we ordered

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\*Read before the Southwestern Branch of the British Medical Association, January 24, 1911.

nutrient enemata of peptonized milk and egg. Bismuth and soda with small doses of carbolic acid and cocaine were given as medicine.

By December 19 vomiting was not arrested and the weight had dropped to 7 pounds 7 ounces. It did not, therefore, seem justifiable to further postpone surgical interference, and we asked Mr. Russell Coombe to operate.

#### NOTES BY MR. RUSSELL COOMBE<sup>1</sup>.

As in most comparatively recently distinguished morbid conditions, the number of cases reported shows a steady increase. That the disease is still frequently overlooked is suggested by the fact that six out of 20 cases seen by Dr. Hutchinson in private were the children of medical men.

Besides the present case only one other case has come prominently to my notice. I refer to Messrs. Harpers' case<sup>2</sup>—and it was the child of a medical man.

In 1903 Cautley and Dent were able to collect 19 cases operated on; in 1906 Fisk compiled a list of 71 cases so treated; the mortality being 46.47 per cent., with no improvement in the later part of the series.

Fisk's tables show that the operations that have been performed are as follows:

	Cases.	Mortality.
Pylorotomy .....	1	100 per cent.
Gastro-enterostomy ....	42	42.56 per cent.
(1 case with Murphy's button died.)		
Divulsion .....	18 <sup>3</sup>	50 per cent.
Pyloroplasty .....	11 <sup>4</sup>	27.28 per cent.

<sup>1</sup> For the bibliography of this condition the reader is referred to: (1) Dr. Cautley and Mr. Dent's paper in the *Medico-Chirurgical Transactions* for 1903 (Volume 86). (2) Dr. Fisk's paper in the *ANNALS OF SURGERY* for July, 1906. (3) The discussion on the subject in the Section of Pædiatrics at the Toronto Meeting of the British Medical Association in 1906, *Brit. Med. Journ.*, 1906, p. 943, Oct. 13. (4) Dr. Robert Hutchinson's Schorstein Lecture in October, 1910, *Brit. Med. Journ.*, 1910, p. 1021, Oct. 8.

<sup>2</sup> The *Lancet*, August 19, 1905, p. 503.

<sup>3</sup> One case required gastro-enterostomy later; this would raise the failures to 55.5 per cent.

<sup>4</sup> Two of these cases died later; one after 10 weeks from zymotic disease, the other after 5 weeks, cause not stated.

Cautley and Dent state one of the objects of their paper to be to show "that the affection may be successfully treated by pyloroplasty," and Fisk's statistics certainly justify their advocacy of this operation. They quote Monnier, Robson, Moynihan, Abel, Weill, and Péhu, as putting pyloroplasty out of the question on account of either the induration or thickness of the pyloric wall.

In their paper they also point out certain objections to gastro-enterostomy, viz.:

1. The increased exposure of the abdominal contents which it necessitates. More recent experience in abdominal surgery only adds to the force of this argument.

2. The increased time required; this they emphasize by drawing attention to the smallness of the parts concerned and the fact that the delicate manipulations required by the operation, if efficiently performed, must take considerable time. I was particularly struck in my case by the tiny size of the duodenum; it did not exceed three-eighths inch in diameter (about half the size figured in the full size photograph in the *Medico-Chirurgical Transactions* of one of Mr. Dent's cases), and if the jejunum was on the same scale a gastro-enterostomy would have been a very difficult, if not an impossible, anastomosis to make secure.

3. There is increased risk of protrusion of the intestine—this must obviously be the case, and to avoid risk of it a deeper anæsthesia (with its accompanying additional risks) must be procured.

4. The incision has to be prolonged further down. Cautley and Dent and Stiles have both drawn attention to the thinness of the abdominal walls and the separation of the recti in these wasted infants; in my case there seemed nothing but a thinned out layer of fascia, representing the linea alba, between the skin and the peritoneum; by no means an ideal abdominal wound to suture and certainly the less of it the better.

As an old house surgeon of Mr. Clinton Dent's with the confirmation of his opinion given by Fisk's statistics, I had no

hesitation in deciding on pyloroplasty when called on to operate on this case of congenital hypertrophic stenosis of the pylorus.

My incision was a central one, limited to about one and a half inches, its upper end being only a little below the ensiform cartilage. The pylorus was immediately revealed and resembled in size and shape the smallest size Murphy's button. I saw nothing of any abdominal contents beyond the pylorus and the adjacent parts of the stomach and duodenum; the former being greatly dilated and the latter, as I have before stated, of extremely small calibre.

A length of warm gauze from a roll was immediately wrapped round the parts concerned, and had there been any straining, this would, I am sure, have retained the intestines better than flat swabs.

The first incision into the thickened pylorus as it happens did not divide the mucous membrane and this immediately bulged up; there was plenty of it, as has been pointed out by Cautley and Dent. It was then divided, the length of the incision being about one and a half inches. The ends of this longitudinal incision were now brought together to make the central point of union; and all coats were sewn together transversely.

My only difficulty now revealed itself; it is that which has been pointed out, and I, personally, found it a very real one. It was to get anything like a safe union of peritoneum at the ends of the now transverse incision. The hard thickened pylorus could not be so manipulated as to give anything like what I wanted to make the closure safe, without an amount of turning in, which I was afraid would defeat the object of my operation. Fortunately some handy omentum was available, and two or three sutures quickly fixed this over the line of anastomosis.

The gauze was removed and the parts at once returned.

The abdominal wall was, as already stated, so thinned out that only interrupted silkworm sutures, fairly close together, could be used; they are of course a very quick form of suture, as there is no delay in getting the peritoneal edges; a continuous fine catgut skin suture completed the operation.

From start to finish the operation took under half an hour; some five minutes having been lost in attempt to close in the thick ends of the pyloric ring.



At the end of the operation the child was, notwithstanding all the precautions which had been taken, in a much collapsed condition; still it was on the whole better than one might have anticipated. It was at once put on rectal enemata, consisting of one drachm of peptonized milk, with three drachms of saline every half hour, equalling six ounces of peptonized milk and eighteen ounces of saline in 24 hours. The bowels acted twice on the day succeeding the operation and flatus was first noticed a day later. There was no post-operative vomiting. Nutrient enemata (which were well retained) were continued for 72 hours. Then two drachm feedings of peptonized milk were begun, and being found to be well borne, were repeated every two hours during that day; giving three ounces in the 24 hours in addition to the nutrient enemata.

At 96 hours the feeding was increased to three drachms every two hours, equalling four and a half ounces in 24 hours.

On the fifth day a nutrient was, for the first time, returned, but the feeds were increased to one and a half ounces every two hours, giving eighteen ounces in 24 hours. From this time progress was uninterrupted.

Weights were as follows: One week after operation, eight pounds one ounce; two weeks after operation, eight pounds fourteen ounces; three weeks after operation, nine pounds ten ounces, a gain of two pounds three ounces.

From the surgical point of view I desire to draw attention to certain points connected with the operation.

First as to choice: Pylorotomy or gastro-enterostomy by Murphy's button was of course out of the question; the former is by universal consent put out of court as too severe, and the latter was equally impossible since no Murphy's button that I possess or have seen is nearly small enough.

Divulsion seems a leap in the dark and does not appear to me to be consonant with modern surgical procedures and knowledge.

There remained then for serious consideration: Gastro-enterostomy, pyloroplasty, and Finney's operation.

I decided on pyloroplasty, and I think wisely; had I decided on gastro-enterostomy I believe, judging from the size of the

duodenum, that I should have found the jejunum so small as to necessitate an abandonment of my intention.

Finney's operation was rather tempting, but I thought on full consideration the amount of stitching it required would take longer, and time was everything.

There are certain changes in procedure I shall adopt if I ever have to operate for this condition again. I should make a transverse incision in the peritoneum over the pylorus, and strip it back on each side in a longitudinal direction. I should then divide the thickened pyloric ring in the longitudinal direction down to, *but not including*, the mucous membrane. There is, as Cautley and Dent have pointed out—indeed almost complained—plenty of mucous membrane; it is in no way implicated in the narrowing. I should next separate the thickened pylorus to its upper and lower poles from the mucous membrane and cut it away. It would then be quite easy to invert and bring together the transverse incision in the peritoneum without any tension whatever.

I have carefully looked to see if this procedure has been previously suggested, and the only hint of it I can find is one line in Dr. Cautley's opening address at Toronto where he says: "If the muscle is very thick and hard, a portion on each side can be snipped out before suturing." I trust that some surgeon with greater opportunities of seeing these cases than can fall to my lot will give my suggestion a trial.

NOTE BY DR. SHIRLEY PERKINS on the anæsthetic used and the means employed to combat shock.

To give an anæsthetic to an infant, even in good health, at seven weeks, for an abdominal operation, is a very serious matter, and the outlook cannot in any way be considered a hopeful one, but when there is combined with this tender age, such a degree of emaciation and general collapse, induced by continuous vomiting, as was presented in the case under discussion, the outlook seemed absolutely hopeless.

Before administering an anæsthetic in a case of this nature, it is particularly necessary to save the child's vital forces by every means in our power, so that it can contend with the severe

shock following such an operation. Every little helps, and the preliminaries to anæsthesia are most essential.

In the present case the precautions taken were as follows: (1) The room was kept very warm. (2) The stomach was washed out with normal saline until the returning fluid was free from mucus, etc. (3) The child was enveloped in a dress of gamgee tissue carefully warmed before being put on—only sufficient of the abdomen being exposed for the incision. (4) Small hot bottles were placed at the sides and feet. (5) During the operation normal saline with brandy was slowly injected per rectum by means of Mr. Arbuthnot's transfusion bag and apparatus.

Now, as regards the choice of an anæsthetic, it seemed to me to be highly dangerous in a child so weak and ill to give chloroform to the degree that was necessary for an abdominal operation, and to obliterate any chance of straining with prolapse of the bowel, and thus to interfere with the rapidity of the surgeon's work. I therefore decided to begin with just a few drops of chloroform on a Skinner's mask, and passed rapidly on to open ether given on the same mask. This I found the child took well, and I was able to maintain a good enough anæsthesia for Mr. Russell Coombe to finish his operation within about half an hour of commencing. The ether seemed to stimulate the child, and it went through the operation very much better than anyone had dared to hope.

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NOTE.—Extract from a letter of March 24, 1911, from the child's mother:

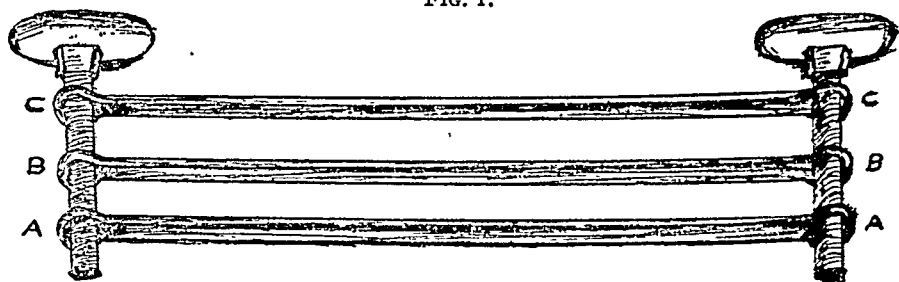
"He now weighs 15 lbs. 13 oz. and gains about 2½ oz. every day—last week he put on 1 lb. 3 oz. . . . He never seems to suffer in the slightest from indigestion, but has become the most vigorous of babies."

## A SIMPLIFIED GASTRO-ENTEROSTOMY CLAMP.

BY WILLARD BARTLETT, M.D.,  
OF SAINT LOUIS, MISSOURI.

THE Doyen clamp and its modifications have rendered gastro-enterostomy safe and easy by enabling us to prevent the escape of blood and visceral contents. There are, however, certain mechanical drawbacks to any instrument constructed upon that plan. It is not possible for its blades to exert uniform pressure at every point. Tissue which happens to be very near the joint is exposed to a crushing force, while that near the tips may be compressed to the point desired, and still the blades be widely apart at the middle. Furthermore, pressure cannot be graduated to any degree desired, since one notch near

FIG. 1.



Gastro-enterostomy clamp.

the handle makes a vast difference in the crushing force exerted on tissue, which may already be tightly held between the blades.

As noted in Fig. 1, the contrivance which I propose is made up of three parallel bars, *A A*, *B B*, and *C C*, *A A* being threaded to run on screws on either end, while *B B* and *C C* are free, and the action of the thumb screws is to draw all three bars together.

Rubber tube can be drawn over the three cross-bars by simply removing one of the screws, which is then replaced and the instrument thus made ready for use.

It is my custom to employ it as follows: The cross-bars are set at a distance of one centimetre from each other. Two catch-forceps draw the stomach up through one interspace, while the intestine is similarly engaged in the other. The de-

FIG. 2.

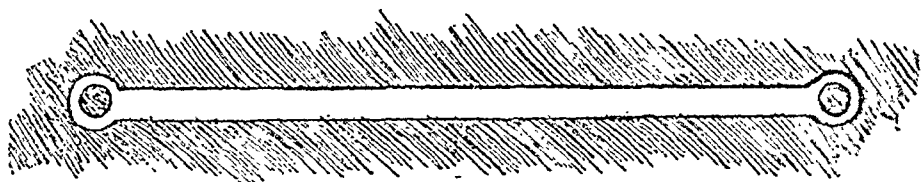


Diagram of rigid steel cross-bar.

sired position of the viscera having been thus secured the bars *AA* and *CC* are pressed against them by the operator's thumb and fingers, until by this direct and accurate means he has secured exactly the pressure which is deemed necessary

FIG. 3.



Cross section of bar (actual size).

and safe, then the whole is locked *in statu quo* by turning the screws until they engage.

I have used the instrument without a third bar between the viscera, but this is not to be recommended, since they tend thus to slip laterally away from one another.

# THE PATHOLOGY AND SYMPTOMATOLOGY OF GALL-STONES.

BASED UPON AN EXAMINATION OF OVER 400 CASES OCCURRING AT THE  
LONDON HOSPITAL.

(Continued from page 109 of last issue.)

BY ALBERT J. WALTON, M.S. (Lond.), F.R.C.S. (Eng.), M.B.,  
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## COMPLICATIONS OF CALCULI IN THE BLADDER.

### I. *Acute Cholecystitis.*

This condition is a not uncommon complication of gall-stones, all cases of cholecystitis being generally dependent upon the presence of one or more calculi. Rigby<sup>92</sup> found in his series of 46 cases of cholecystitis, that gall-stones were present in all but two. In this series of cases of gall-stones there were 78 cases of acute cholecystitis.

The following varieties may be present:

*Acute Catarrhal Cholecystitis.*—It is probable that this condition is extremely common with gall-stones. As already mentioned there is considerable evidence that the diffuse pain occurring with stones in the gall-bladder is dependent upon a condition of inflammation, and with the acute attacks it is probable that there is an acute catarrh of the gall-bladder. Many cases are seen in which the patient has acute pain over the epigastrium and right hypochondrium with rigidity and tenderness. At the onset pyrexia and vomiting may be present. Within a few days the severity of the symptoms is greatly decreased, so that local tenderness or perhaps a tumor due to the enlarged and dilated bladder may alone persist. As already described, an acute catarrh is probably the first stage in the formation of gall-stones, but symptoms appear to be much more marked when gall-stones are present, that is to say when the acute catarrh supervenes on a chronic cystitis.

*Acute Suppurative Cholecystitis.*—This may occur as two distinct conditions:

(a) Without obstruction: In this case the condition is simply a further stage of the acute catarrhal cystitis, the inflammation has spread beyond the mucosa to the other constituents of the wall of the gall-bladder. Leucocytes are poured out and pus is thus formed within the cavity of the gall-bladder. There are often hemorrhagic areas beneath the mucosa which is acutely inflamed and commonly ulcerated, especially at those spots at which it is exposed to the pressure of the calculi. The gall-bladder is generally dilated, and its walls thickened and œdematous, often deep red in color, and showing infected vessels. On the outer surface there may be many recent adhesions and deposits of lymph. The bladder itself contains pus or mucopus mixed with bile and in some cases stained with blood. Rarely this condition may occur apart from calculi, as in one of the cases reported by Rigby.<sup>92</sup>

In this series there were 34 cases of acute suppurative cholecystitis dependent upon gall-stones, in which there was no evidence of obstruction of the cystic duct and neck of the gall-bladder. Six were acutely inflamed without the presence of pus, apparently simply a catarrhal condition, whilst eight showed changes noted as hyperplastic cholecystitis, apparently a chronic inflammatory change with thickening of the walls together with a recent inflammatory change.

Symptoms: Not uncommonly the condition may start as a catarrhal cholecystitis, although in the majority of cases a previous history of gall-stones in the bladder can be obtained. In some cases there is an interval of improvement after the acute catarrhal attack, to be followed by severe symptoms with the formation of pus. Such a case has been recorded at length by Monsarrat.<sup>72</sup> More commonly there is a sudden onset of severe pain in the epigastrium and right hypochondrium, radiating to the back and shoulders, and accompanied with marked tenderness and rigidity of the abdominal walls, especially on the right side. There is nausea and repeated vomiting with pyrexia and a rapid pulse. Such a condition

may closely simulate a case of acute appendicitis. If untreated, the inflammatory change may be progressive, and ultimately rupture or perforation of the gall-bladder take place; more commonly, however, there is some abatement of the symptoms, this being slow, in contradistinction to the rapid changes which may take place when a stone is impacted. The rigidity and tenderness may sufficiently disappear for the inflamed and enlarged gall-bladder to become palpable.

(b) With obstruction: In this condition, which is rather less frequent than the last, a calculus has become impacted in the cystic duct or neck of the gall-bladder. If the infection be very mild, a hydrops of the gall-bladder will first develop, the fluid gradually being converted into pus so that an empyema is slowly formed. If, however, the infection be acute, very severe inflammatory changes may be set up and give rise to a more rapidly progressive condition than in the last case.

In the milder cases, the gall-bladder may be simply dilated and show a few old or recent adhesions, the walls being perhaps a little thickened. The fluid drawn off may be at first clear and mucoid, the deeper layers only containing pus. In other cases the whole fluid may be purulent, but only slight inflammatory changes are present. Even in such cases the mucosa will often show areas of necrosis and ulceration, these being most marked either at the fundus or at the neck at the site of impaction of the gall-stone.

In the more acute cases the gall-bladder is markedly inflamed, there are adhesions and deposits of lymph, whilst the wall is oedematous and vascular. The fluid contained in the bladder is purulent and may be foul, in some cases being mixed with altered blood and sloughs from the injured wall. The mucosa is irregular, ulcerated, and often hemorrhagic. In some cases areas may slough through and the contents thereby escape into the peritoneal cavity, rapidly giving rise to a diffuse suppurative peritonitis. This gangrenous change usually takes place in the fundus of the gall-bladder, as in a case reported by Monsarrat,<sup>72</sup> secondary to an impacted



cholesterin calculus, and another figured by Moynihan.<sup>74</sup> If the perforation be less acute, it may be shut off by adhesions and a localized abscess arise as in cases of chronic ulcerative cholecystitis.

**Symptoms:** In the milder cases the symptoms will commence with those characteristic of a stone impacted in the cystic duct, and indeed nothing further may be noted. If an infection be also present, the symptoms are severe, usually more so than when cholecystitis occurs without obstruction. There is a sudden onset of severe pain, which may at first be colicky in nature, but later becomes more constant and radiates from the abdomen to the back and shoulders. There is tenderness and rigidity, at first of the whole abdomen, later localized to the right hypochondrium. The respirations are shallow and jerky, of the peritoneal type, and abdominal movements are decreased. With this there is constipation and repeated vomiting, often of bile. While the pain is of the nature of colic the patient may be collapsed, but as this is replaced by the more constant but less severe inflammatory pain, the temperature will rise to  $102^{\circ}$  or  $103^{\circ}$ . As Moynihan<sup>74</sup> has pointed out, the temperature chart often shows a steeple form. This condition if left will generally progress to perforation and then pursue the usual clinical course of a severe diffuse suppurative peritonitis. At times, however, the impacted calculus may be loosened by the inflammatory change and drop back into the bladder, when the acute symptoms usually rapidly subside.

In this series there were 21 cases of acute suppurative cholecystitis secondary to an impacted calculus. Of these eight were of the milder variety and showed little if any evidence of pus previous to operation. In two of them the pus drawn off from the gall-bladder was sterile on culture. The other 13 were of the more acute variety. In addition to these there were two cases where acute ulcers had perforated and led to diffuse peritonitis. These have been considered with gangrenous cholecystitis.

*Acute Membranous Cholecystitis.*—This is a very rare con-

dition in which a membranous cast is formed by the mucosa of the gall-bladder, the condition being generally dependent upon the presence of gall-stones. The membranous cast being separated from the wall of the gall-bladder may remain *in situ* or be passed down the cystic and common ducts. In the classical case recorded by Fenwick,<sup>30</sup> two casts in shape typical of the gall-bladder and stained with bile were passed in the fæces after attacks of biliary colic. This man had previously passed gall-stones. More commonly, however, there will be attacks of colic or pain in the region of the gall-bladder, but the cast will not be passed. It will then be found in the gall-bladder at operation. Rolleston<sup>96</sup> has recorded such a case, Moynihan<sup>74</sup> a further one, and Mayo Robson<sup>63</sup> two that were cured by cholecystotomy.

There were in this series two such cases, in both of which a complete cast was found at operation. In neither was there a history of any cast having been passed and found; in one only had there been colic, this being apparently due to the calculus.

*Acute Phlegmonous or Gangrenous Cholecystitis.*—If by this condition is meant only an acute inflammatory change leading to extensive gangrene of the gall-bladder, then it is very uncommon. Thus Courvoisier,<sup>20</sup> in the extensive number of cases of gall-stones recorded by him, was only able to find seven cases. If, however, localized conditions of gangrene, such as may occur with ulceration around a calculus, are included, the disease becomes relatively common. This probably accounts for the greater frequency of the condition as described by Mayo Robson, who published 57 cases,<sup>64</sup> this number lately having been brought up to nearly 100.<sup>62</sup> In the majority of cases it is dependent upon the presence of calculi. Thus Moynihan<sup>74</sup> has carefully collected eighteen cases, in sixteen of which calculi were present, but an interesting case has been recorded by Lett<sup>55</sup> and another by Wendel,<sup>109</sup> where the gangrene was due to axial rotation of the gall-bladder, which in both cases had a free mesentery. Worthington<sup>114</sup> has reported another case where gangrene and perforation

occurred without the presence of calculi, the condition apparently being due to an acute infection as in Gütig's<sup>39</sup> case. Mention has already been made of cases of acute perforation and gangrene occurring with or after typhoid fever.

In the majority of cases, however, the condition appears to be an acute infection following the presence of gall-stones.

The gall-bladder will be somewhat dilated or collapsed according as to whether rupture has yet taken place. In the earlier stages the walls may be thickened, and on section small areas of pus may be seen, these apparently arising from septic thrombosis of the vessels of the gall-bladder. In later stages the walls are blackened or greenish, with deposits of lymph and pus on the surface, whilst in one area, an irregular opening where the wall has sloughed through is usually present. A diffuse peritonitis is then found.

Among the present cases, there were six in which spontaneous perforation occurred; in one there was no sign of any inflammatory change, although gall-stones were present, and the cause of perforation remains very doubtful. In two others perforation had occurred at the site of ulceration of a calculus in cases of acute suppurative cholecystitis, thus leaving three cases only of true gangrene. In addition to these there was one case described as phlegmonous cholecystitis, in which perforation had not taken place. The wall was thickened and on section pus exuded from it. There was neither pus nor calculi within the gall-bladder, but three faceted stones were impacted in the cystic duct. It is probable that in such cases infection of the wall of the duct may take place at the site of impaction and travel along the vessels and lymphatics to the wall of the gall-bladder.

## II. *Chronic Cholecystitis.*

This is the commonest complication of gall-stones, and it is probable that whenever they have existed for any length of time chronic inflammatory changes will be found in the bladder. Since the stones themselves are the result of a chronic infection, they will mechanically irritate the bladder

and aggravate or maintain the chronic cystitis, so that a vicious circle is formed. In the cases in this series there were 148 showing different forms of chronic cholecystitis. The following varieties may be recognized:

*Chronic Fibrous Cholecystitis.*—This is the most common condition, 121 of the cases of this series being affected in this way. The original catarrhal inflammation of the gall-bladder becomes chronic and exaggerated by the presence of the gall-stones. The changes are no longer limited to the mucosa but spread to the muscular and serous coats, the former of these becomes infiltrated with inflammatory cells, and may, in the earlier stages, be thickened from a fluid exudate. The serous coat at the same time becomes roughened, and in the more acute stages may even show deposits of lymph upon its surface. Structures in the neighborhood, more commonly portions of the great omentum, but not uncommonly gastro-hepatic omentum, abdominal wall, stomach, duodenum, or transverse colon, become affected and adhere to the surface of the gall-bladder.

Later the inflammatory exudates become organized so that the wall of the gall-bladder may be greatly thickened, and as fibrosis takes place, shrunken and distorted, whilst the surrounding adhesions become firmer and more fibrous, so that the pylorus or duodenum may be thereby obstructed.

In long existing cases the gall-bladder will nearly always be found thus contracted, the end result of stones in the bladder being, as a rule, not dilatation but the formation of a shrunken, fibrous structure. Thus of the 121 cases, 26 alone showed any dilatation of the bladder, probably because the lower stone or stones caused partial obstruction to the opening of the cystic duct. The ultimate appearance of the gall-bladder will, to a large extent, depend upon the nature of the gall-stones present. If these are multiple, they may be compressed together to form a mosaic, which tightly fills the gall-bladder and is held in place by the contracted walls of the viscus. The mutual pressure of the gall-bladder and calculus has already been mentioned for the case of only one large

gall-stone, the result being that the irregularities of the surface of the calculus fit into corresponding depressions of the gall-bladder. If, however, the calculus partially obstruct the cystic duct, the gall-bladder may be somewhat dilated.

In many cases the fibrosis may extend from the gall-bladder to the neighboring portion of the liver and thus lead to difficulty in removal.

If only two calculi of considerable size are present, the bladder may contract around them and a typical hour-glass condition result, the two cavities being separated by a narrow canal. A similar condition may arise with only one stone. If this be situated in the fundus, this area of the bladder may show marked inflammatory changes and may contract around the stone, while the lower portion of the bladder will be relatively free from such changes and will maintain the normal size of its lumen, so that it will communicate with the cavity above containing the stone by a relatively narrow lumen. The method of formation of such a condition is well shown by the fact that the wall around the calculus and the isthmus shows much inflammatory thickening, whilst that around the lower cavity is of normal or only slightly increased thickness.

The condition seems to be uncommon, for among these cases an hour-glass form of the gall-bladder from inflammatory changes was only noted in 2 cases.

If there be only one or several small stones, the contraction of the gall-bladder may be extremely marked, so that a small, hard, shrunken area is alone left. In many such cases the shrinkage may be so marked that it becomes difficult or almost impossible at operation to discover the gall-bladder, which at the same time is usually surrounded by dense adhesions.

In some cases calcareous changes may take place in the wall of the thickened gall-bladder. In cases which have existed for many years it is not at all uncommon to find small calcareous areas in the greatly thickened fibrous wall. In some rare cases, however, the condition becomes much more marked, and the whole thickness of the wall becomes a stony

mass. In such cases as in one in this series, the walls may be  $\frac{1}{2}$ –1 inch thick, the calcareous matter being peculiarly laminated and having a very close resemblance to bone. The cavity of the gall-bladder may be shrunk or distorted from the irregular shape of the walls. It is generally lined by an altered and inflamed mucosa, but this structure can, as a rule, be definitely recognized, and is unaffected by the calcareous change. Such gall-bladders show dense and firm adhesions to the surrounding structures, but provided these can be separated there will not, as a rule, be difficulty in removing the bladder, for the calcareous changes end at the commencement of the cystic duct.

*Chronic Ulcerative Cholecystitis.*—The presence of ulceration occurring in the acute conditions has already been described, but it may also occur in the more chronic inflammations either in the bladder or ducts. If a gall-bladder be contracted around a stone or stones, the mucosa in contact with them often shows ulceration. This is most common either at the extreme fundus of the gall-bladder or in the dilatation just proximal to the origin of the cystic duct, Hartmann's pouch. In some such cases the mucosa may, in this way, be completely ulcerated through and the calculi thus come to lie in submucous pouches or diverticula, the condition then very closely resembling an hour-glass or other deformed and loculated gall-bladder. In only one of these cases, however, was a distinct locus noted.

More commonly, as the gall-bladder contracts the ulceration tends to progress, and inflammatory changes in the overlying serous coat become more marked, so that, if not present before, adhesions to surrounding structures are formed. In some cases these adhesions are attached to the liver or abdominal wall, so that when the gall-stone has completely ulcerated through the walls of the bladder it comes to lie in a secondary cavity outside. In the former case an abscess within the liver substance containing the gall-stone may be formed, or in the latter the cavity may gradually extend outwards through the abdominal wall until the skin is per-

forated, usually somewhere in the neighborhood of the umbilicus, and the calculus is spontaneously discharged. If the diverticulum be at the neck of the bladder it may cause pressure upon the common duct, portal vein, or duodenum. In four cases of this series it was noted that such a pouch caused pressure upon the common duct. In Courvoisier's<sup>20</sup> analysis of 169 cases of external fistulæ, it is shown that such external fistulæ may open in many situations often remote from the gall-bladder. Porges<sup>85</sup> has recorded one that opened on the thigh. Of Naunyn's<sup>78</sup> 384 cases, 184 opened on to the abdominal wall. In seven of the cases in this series it was noted that an abscess was present around the gall-bladder, but in only one apparently was a sinus spontaneously formed.

In other cases adhesions may be formed between a hollow viscus and the gall-bladder. As the calculus passes from the gall-bladder it will then gradually ulcerate into this viscus, and the stone be discharged therein. This most commonly occurs in the case of the duodenum, and the calculus which is often very large, that is too large to pass down the cystic duct, may pass along the small intestine, but often becomes impacted in some part of its course and gives rise to acute intestinal obstruction. In some cases the stone may remain impacted within the fistula for a certain time, when the end projecting into the duodenum may become enlarged, the chyme depositing phosphates upon it as described by Barnard.<sup>6</sup> Very rarely the stone may make its way into the small intestine by ulcerating into the ileum as in one of the cases reported by Courvoisier.<sup>20</sup> In other cases a calculus large enough to cause intestinal obstruction may have passed down the common duct. Stones of this size will have developed in size while impacted in the common duct and may have led to great dilatation of it. Even in such cases it is very probable that a choledochoduodenal fistula has been formed, but that it has not passed through a fistula between the gall-bladder and duodenum is shown by the fact that post mortem such a fistula may be absent. Of his 36 cases Courvoisier was only able to accept four as following this route.

Naunyn in his analysis of 384 cases of fistula found 108 connected with the duodenum, 93 of which came from the gall-bladder, the rest from the common duct. Barnard<sup>7</sup> found that intestinal obstruction from gall-stones occurred in the proportion of 1 in 44.6 of all cases, in the majority of cases previous symptoms of gall-stones being present. In this series of 409 cases there were 13 cases of acute obstruction in which a previous history pointing to gall-stones was noticed in 8. In addition to these there were 7 others in which a fistula between the gall-bladder and duodenum was found at operation.

Occasionally a calculus having passed within the intestine may cause intestinal obstruction by giving rise to a volvulus, as in two cases recorded by Mayo Robson.<sup>65</sup>

Not uncommonly the fistula may communicate with the transverse colon. In Naunyn's <sup>78</sup> series there were 49 cases in which the fistula communicated with the gall-bladder and transverse colon, while one passed between the colon and common duct. In this series there were only two such cases. With such a fistula intestinal obstruction is much less likely to be caused, the larger calibre of the colon allowing the calculus to pass, although at times it may be impacted at the anus or may be felt per rectum as in a case recorded by Sir F. Eve.<sup>28</sup>

Very rarely the fistula may connect the gall-bladder with the stomach. Naunyn gives 12 such cases in his list. Mayo Robson mentions that he has had 5 cases and reports 2 fully. In such cases the fistula usually opens into the pyloric portion of the stomach close to the lesser curvature. The condition may give rise to continuous vomiting of bile-stained material, or the calculus itself may be vomited.

Voelcker<sup>106</sup> has recorded an extraordinary case where three fistulae were present, opening into the pylorus, duodenum, and transverse colon.

In exceptional cases gall-stones may pass into the urinary passages. Michel<sup>69</sup> records a case where four calculi were removed from the urinary bladder at one operation, and



Murchison<sup>76</sup> one where as many as 200 biliary calculi were passed from the urethra. Moynihan<sup>74</sup> mentions one of his own cases where a stone ulcerated into a renal pelvis dilated behind an impacted urethral calculus. He also quotes cases of Faber Kronlein and V. Bergmann where the stones passed from the gall-bladder through a fistula into a patent urachus and so into the bladder.

In this series there was no actual case of a fistula communicating with the bladder but in one the liver was much prolapsed, and an abscess around the gall-bladder was found at operation to have its lower wall formed of the urinary bladder.

A few cases have been recorded of fistulous communication with the female genital organs, especially the pregnant uterus, but there seems to be doubt in some whether the communication was not really with the vagina. Lucy<sup>57</sup> records one case where the fistula communicated with an ovarian cyst.

In other cases the fistula may communicate with the thoracic viscera. Naunyn collected 10 such cases, Courvoisier 24. Two cases have been recorded by Rigby<sup>93</sup> and Mayo Robson<sup>96</sup> that were successfully treated by operation. In such cases the communication is probably either made through a subphrenic or hepatic abscess which has perforated the diaphragm.

Lediard<sup>52</sup> recorded a case in which he removed an appendix containing eleven small gall-stones; these had, however, probably passed into the small intestine and from there into the appendix.

*Villous Cholecystitis*.—Rarely a chronic inflammatory condition of the gall-bladder is associated with an hypertrophy and overgrowth of the epithelium instead of with ulceration. This change may be diffuse or limited to one small area. The former is the more common. The whole of the mucosa here may be thickened to form a velvet-like lining to the gall-bladder, or if the viscus be distorted and sacculated it may be limited to those areas in contact with the calculus. In any case it is limited abruptly at the origin of the cystic duct.

On section the mucosa is seen to be much thickened, the glandular tubes being stronger and more convoluted than normal.

If localized the condition may form definite papillomata; such conditions are rare, definite papillomata being only noted in three of the cases of this series. Zenker<sup>115</sup> has regarded this condition as an early stage of carcinoma. In one of the cases of this series a papilloma sprang from the fundus and filled the gall-bladder, being  $2\frac{1}{2}$ –3 inches long. It showed extensive malignant changes.

In many cases of chronic cholecystitis there is a marked prolongation of the right lobe of the liver to form a linguiform process. As Riedel<sup>90</sup> has pointed out, this is so commonly associated with gall-stones as to be probably in some way dependent upon them. Although as a rule associated with an enlarged gall-bladder, it may be present with a chronically inflamed and shrunken bladder containing calculi. In this series such a prolongation was noted as being present in 8 cases, although it is probable that to a lesser degree it was present in many more. Of these 8 cases, 3 showed a dilated, 5 a contracted and fibrous gall-bladder.

### III. *Calculi in the Cystic Duct.*

In many cases the gall-bladder will contract upon the enclosed stones which will be forced down the cystic duct. If the calculi are relatively small they may ultimately traverse the whole length of the cystic and enter the common duct. If very small it is possible that the calculi may pass down the duct and give rise to no symptoms whatever. It may in part be owing to this fact that in so large a number of cases many years may elapse without any symptoms of the passage of stones down the duct, although in the majority of cases it is due to the fact that the calculus has remained fixed within the gall-bladder. In this series there were 258 cases giving symptoms of the passage of calculi down the ducts, of these 182 had a previous history of calculi within the gall-bladder, which in many cases was of several years duration. This was

specially noticeable in those cases where the calculus was impacted in the duct (see later).

Symptoms: The characteristic symptom of the passage of a stone down the cystic duct is an attack of biliary colic. These attacks may be multiple, either because several stones are present or because one calculus too large to pass down the cystic duct slips back to the gall-bladder, only to enter the duct again at a later date.

In many cases, *i.e.*, 182, there were previous symptoms of gall-stone disease, although it is probable that in the remaining 76 there were such symptoms, but in too slight a degree to have made any lasting impression upon the patient's mind. Of these 182 cases 29 showed the more severe diffuse pain, which has been regarded as the clinical evidence of chronic inflammatory changes in the gall-bladder. In some cases this type of pain has been so severe that in the history it is difficult to distinguish between it and true colic. These figures strongly support what Moynihan, Mayo Robson, Sutton, and others have laid so much stress upon, namely, that the presence of colic must be regarded as a late complication of gall-stones rather than as a symptom of their presence. The absence of colic does not in any way negative the presence of gall-stones.

As a rule the attack of colic comes on with remarkable suddenness and is dependent upon no recognizable cause, not uncommonly appearing first at night time. As a rule, it lasts only for a short time and disappears as suddenly as it came, the stone having either passed or returned to the gall-bladder.

If there have been many attacks of colic without jaundice, and no stones have been found in the stools, although searched for carefully, there is probably only a single calculus, whereas if one or other or both of these latter conditions have been noted, probably many calculi are present; but it is only possible to distinguish between the varieties of multiple calculi when one has been passed in the *fæces* and has been examined.

#### IV. *Impaction of Calculi in the Cystic Duct.*

A stone passing down the cystic duct may become impacted. If this impaction be complete one of two things may happen. If the infection of the gall-bladder is acute, the complete obstruction to the natural path of drainage will be followed by an acute suppurative or gangrenous cholecystitis. If, on the other hand, the infection be less the calculus will remain in position and, since no bile pigments are in contact with it, it will gradually become coated with and probably later completely transformed into pure cholesterin. As already mentioned, Aschoff and Bacmeister<sup>3</sup> came to the conclusion that pure cholesterin calculi only occur in sterile bile, while if inflammatory changes are present calcium is also found in the calculus. In this series of cases there were 89 in which at operation a calculus was found impacted in the cystic duct; 21 of these were associated with an acute suppurative cholecystitis. Of these only 2 were noted as being formed of pure cholesterin, although of the 5 cases of pure cholesterin calculi, and the 4 coated with cholesterin which were bacteriologically examined, 7 contained organisms.

These figures therefore seem to show that with laminated or mixed calculi the infection is likely to be severe, but with cholesterin calculi the fluid is certainly not sterile; the explanation probably being that in the highly infective conditions immediate operation has to be done and the mixed calculus is found. If the infection be less severe the calculus grows *in situ*, and pure cholesterin is deposited upon it, the gall-bladder dilating behind it meanwhile.

If the obstruction be not complete the calculus will steadily grow *in situ*, but in this case bile pigment will also be able to trickle past the calculus, so that the newly formed material will contain pigment calcium in addition to cholesterin. If more than one is present they will form together a barrel-shaped mass, the individual stones being faceted on their contiguous sides. As mentioned previously, in such cases the more recently deposited material is often not laminated but forms a homogeneous material on the surface. With a

partial obstruction of this nature one would expect to find a very great dilatation of the gall-bladder corresponding to the condition seen with an intermittent hydronephrosis, and it is interesting to note that Bland Sutton<sup>10</sup> states on this point: "It is also a noteworthy point that the largest gall-bladders which have come under my observation—I mean those big enough to be mistaken . . . for a cystic kidney or even an ovarian cyst—were obstructed by large barrel-shaped calculi of the character just described." In this series there were seven cases in which the gall-bladder was noted as being excessively dilated. In 5 of these the condition was noted as: gall-bladder down to right iliac fossa, greatly dilated, contained 1 pint, contained  $\frac{1}{2}$  pint (2 cases). In these 5 cases a column of 3 calculi was found 3 times, 2 calculi once, and 1 mixed calculus once; in the 2 remaining cases the gall-bladder contained 1 pint and  $\frac{1}{2}$  pint respectively of mucus, the calculus in these cases being one of pure cholesterin which completely occluded the cystic duct.

In some cases a calculus which is impacted in the cystic duct may be large enough to cause definite effects upon the surrounding structures. The size of the calculus alone is usually insufficient to cause this pressure, but it is aided by the fact that firm adhesions are usually present. Moynihan<sup>74</sup> records a case where a stone impacted in the lower part of the cystic duct caused fatal pressure upon the common duct and portal vein. McArthur<sup>67</sup> also records one of pressure upon the common duct. In this series there were 3 such cases, where with a stone in the cystic duct constant jaundice had been present for 3 weeks, 7 weeks, and 5 months respectively, the condition being completely recovered from when the stone was removed from the cystic duct.

Symptoms: As in the last case there is usually a previous history of calculi within the gall-bladder. In this series of 89 cases there were 61 showing previous dyspeptic symptoms and 45 with a history of past attacks of colic.

With impaction three different groups of symptoms may occur:

(a) These commence either with an attack of colic or severe pain of the inflammatory type, the condition soon passing on to one of acute suppurative cholecystitis. In this series there were 21 such cases, 10 of which had had no previous attack of colic, although the size of the stone suggested that it had been present for some years. In such cases it is probable that the calculus was impacted in the gall-bladder, but with the onset of more acute inflammatory changes it became loosened, and was able to pass down and occlude the cystic duct.

(b) In this group the symptoms of impaction also commence with an attack of colic, which may or may not have been preceded by other attacks. This colic gradually decreases and is replaced by a constant dull pain, which is shortly accompanied with dilatation of the gall-bladder. In this series there were 56 such cases.

(c) Less frequently, an attack of colic may be absent, but the patient has complained of dyspeptic symptoms or the more severe refined pain perhaps for some months. At the commencement of or shortly after these symptoms a tumor due to the presence of a dilated gall-bladder can be distinguished. There were 12 such cases in this series.

From a consideration of these symptoms it is not uncommonly possible to diagnose the nature of the calculus and whether it be single or not. Thus, if there be an onset of severe colic followed by symptoms of acute suppurative cholecystitis, sufficient time will not have elapsed for the calculus to have become coated with pure cholesterin, or to have been converted into this substance; it will therefore be either a laminated and faceted or a mixed calculus. If previous to this onset there have been many attacks of colic with jaundice, there must have been other stones which were passed, and therefore the calculi will be multiple, faceted, and laminated. If, on the other hand, this attack of colic be the first one, there is probably a single calculus. Even with such a single calculus there may have been many attacks of colic, but these, although terminating abruptly, will not have been associated with

jaundice. The calculus will have passed back into the bladder and not into the common duct.

If there have been many attacks of colic followed by jaundice, and then one attack is followed by dilatation of the gall-bladder without signs of acute suppurative cholecystitis, the condition for the same reasons is more likely to be due to multiple calculi.

If but one attack of colic has been present, or dilatation has started insidiously after dyspeptic symptoms, and if there is no evidence of acute suppurative cholecystitis, a simple enlargement of the gall-bladder having been present for some months, the condition is almost certainly due to a single calculus, either of pure cholesterin, or with a thick outer layer of pure cholesterin.

If the dilatation be enormous and has existed for many years, the obstruction will probably be due to calculi, often three or four in number, which have only partially obstructed the duct and have been steadily growing *in situ*.

Excepting in the last group of cases, the dilated gall-bladder will not contain bile. In the early stages bile may be present, but once the obstruction is complete this is absorbed, or at any rate disappears and is replaced either by clear mucus, mucopus, or pus alone. The pathological changes and symptoms already described under the various headings of cholecystitis may then be present.

#### V. *Calculi in the Hepatic Ducts.*

Calculi are less common in the hepatic ducts than in any other part of the biliary tract. Michaux<sup>68</sup> has laid stress upon this fact, and regards all such calculi as secondary to stones in the bladder or common duct. In this series of cases there were but four in which it was noted that calculi were present in the hepatic duct. Such calculi may be of two varieties. In the first place masses of pure pigment calcium may be seen which are formed *in situ*. Such a condition is generally regarded as being very unusual, but it is probably not uncommon, the calculi usually, however, passing into the

cystic duct and gall-bladder, and in the latter situation forming a nucleus of one of the more common varieties. Calculi of this nature (Figs. VI, and VIII, Plate I) are not unusual. In this connection it is interesting to note that the calculi shown in Fig. VIII were removed from the gall-bladder of a case from which a large mass of pigment calcium, as shown in Fig. VII, was removed from the hepatic duct, which strongly supports this view as to their origin. Of the four cases of hepatic calculi, three were formed of pure pigment calcium.

In the second place calculi may occur in the hepatic duct in association with those in the bladder and common duct. Such stones are much more commonly of the faceted type. Such calculi are usually regarded as more common, but in this series only one case was noted as containing calculi of this variety, the specimen being preserved in the Hospital Pathological Institute. There is no doubt that these stones have passed backwards from the common duct, as they are always similar in nature to those found in this latter situation. Moynihan's observation<sup>74</sup> that in all his cases the calculi were easily milked downwards and removed through the common duct incision is in favor of this, as is also the fact that in the case in this series all the calculi were in the lower part of the hepatic duct.

#### VI. *Calculi in the Common Duct.*

Calculi having passed down the cystic duct will enter the common duct, and may traverse the whole of this to be ultimately passed into the duodenum, so that not uncommonly patients having symptoms of gall-stones may pass them in the fæces, although it must be remembered that in some such cases the calculi have entered the intestine through a fistula. As in the case of the cystic duct, small calculi may possibly pass down the common duct and give rise to no symptoms. The frequency of such a condition is, however, difficult to estimate, as it is relatively rare for the fæces to be carefully examined previous to admission for the presence of stones.



In this series it was only noted in 22 that calculi had been previously found in the fæces; of these only one had not had jaundice. In some cases where calculi are passed and no jaundice is present, a fistula may be present and the calculus thus not have passed down the common duct. Of the above 22 cases only one was found at operation to have a fistula between the gall-bladder and intestine. In this case jaundice had been present. But of the cases of acute intestinal obstruction a note was made of the condition of the gall-bladder in three, all of these showed a fistula between the bladder and intestine. At operation stones may at times be found in the common duct when there have been no symptoms pointing to their presence there. Thus Moynihan<sup>74</sup> mentions that he has twice found stones in the common duct when symptoms were wholly lacking, and in two cases of this series calculi were found here, with no evidence of past or present jaundice. For this reason the cystic and common ducts must always be examined during an operation for gall-stones.

Symptoms: The characteristic symptoms of the passage of calculi down the common duct are attacks of colic followed by jaundice. Often in such cases there is a previous history of local or diffuse pain due to calculi in the gall-bladder. Later this is followed by attacks of colic unassociated with jaundice and due to the passage of calculi down the cystic duct. Later still jaundice follows the colic, pointing to the fact that the calculus has now entered the common duct. In this series 232 cases in all showed or had a history of jaundice. In 54 of these the patient gave no history of any symptoms previous to the attack associated with jaundice; 138 gave a history of previous symptoms pointing only to calculi in the bladder, until the onset of the attack with jaundice, that is to say, there was no previous history of colic without jaundice; 40 cases gave a previous history of pain and attacks of simple colic.

These attacks of colic and jaundice last, as a rule, but for a few days, unless the stone becomes impacted. During this time the stools may be white or clay-colored and the urine darkly pigmented.

VII. *Impaction of Calculi in the Common Duct.*

When a calculus has entered the common duct it may become impacted and cease to pass downwards. At first this impaction is complete, but later, as described by Osler<sup>84</sup> and Fenger<sup>29</sup> the stone becomes loosened and a certain amount of bile is allowed to pass. This is brought about partly by inflammatory softening of the duct around the calculus and partly by dilatation of the duct behind it, so that often the calculus forms a ball valve. In some cases the duct behind the calculus may be enormously dilated, as in a case reported by Edgeworth.<sup>27</sup> In this series there were 75 cases of stone impacted in the common duct. Of these two showed extreme dilatation of the duct. Rolleston<sup>96</sup> describes a saccular and a cylindrical variety of this dilatation, the former of which is generally limited to the common duct, the latter usually involving the hepatic and intrahepatic ducts.

The calculi may become impacted in any part of the duct, but they are more common in the lower part. Of Courvoisier's<sup>20</sup> 123 cases 41 were in the ampulla and 20 close to the duodenum. In any case the calculus may grow *in situ* and, if several be present, may form a column of articulating segments closely fitting the duct. In three cases such a column was present. The outer layers of these calculi may consist of all the normal constituents or may be in large part formed of soft friable pigment calcium. In other cases the greater part of the calculus is thus constituted and forms a soft, putty-like mass moulded to fit the common duct. A mass thus formed in the common duct may be sufficiently large to press upon the portal vein as in a case reported by Westenhoffer,<sup>110</sup> where thrombosis of the vein had been caused.

As a general rule the gall-bladder is contracted according to Courvoisier's law. In this series, however, this has not been as constant as is usually reported. Thus of the 75 cases, 58 showed a contracted bladder, this structure being dilated in 17 cases. Courvoisier's explanation of this, which is usually accepted, is that there is old standing cholecystitis which has led to contraction and shrinkage of the gall-bladder. Such an

explanation seems, however, hardly adequate, for, as already pointed out, many cases of impaction of a calculus in the cystic duct show a long previous history of stones in the gall-bladder, and thus similar chronic cholecystitis should be present, but in such cases dilatation is almost the rule. It is more probable that as in the case of impaction of a calculus in the ureter, sudden and complete blockage of the duct is followed, not by dilatation, but by a cessation of the secretory function of the organ behind it. Thus in this case slowly developing or partial obstruction of the duct may be expected to be associated with a dilated gall-bladder. Dilatation of the gall-bladder may, of course, also occur with jaundice if the calculus be impacted in the cystic duct in such a manner as to compress the common duct, as in the three cases in this series, already mentioned, or if the stone be impacted in the opening of the cystic duct and project into the lumen of the common duct so as to obstruct it, as in two further cases in this series.

When the stone has become impacted inflammatory changes are very likely to take place. These may be local or diffuse. In the former case ulceration will occur around the impacted stone and, in the first place, may tend to loosen the calculus. If the condition continues, perforation of the duct may take place, the infected bile escape into the peritoneal cavity, and a diffuse peritonitis be set up. This is, however, rare, only one such case occurring in this series. If the ulceration be more chronic, adhesions may first form between the duct and surrounding viscera, so that as the ulceration continues, fistula between the two is caused. Such a condition is rare, no case being recorded among this series. Courvoisier,<sup>20</sup> and Moynihan<sup>74</sup> have both laid stress upon the fact that a calculus may not uncommonly ulcerate through the intraduodenal portion of the duct into the duodenum, the condition being then often mistaken for a wide-mouthed ampulla. Rarely ulceration of the duct may be followed by stenosis, as in a case recorded by Pye Smith.<sup>87</sup> Special attention has been drawn to this complication of late years owing to the difficulties in treatment if the condition arise after the gall-bladder has been removed at operation. This complica-

tion seems to be very rare. There was not a single instance of it among these cases.

In other cases the inflammatory changes are more diffuse and may pass up the duct so that a suppurative cholangitis is caused. In this series there were five such cases. The condition, although fortunately not common, is nearly always dependent upon gall-stones. In Rogers' <sup>94</sup> series of 20 cases, 18 were due to gall-stones.

If a calculus be impacted in the papilla of Vater pancreatitis may be caused. The acute condition may be due to regurgitation of bile along the pancreatic duct, as has been shown by Halsted and Opie.<sup>40</sup> Although it is more likely to occur if there be no accessory duct of Santorini, yet it is probably, in the majority of cases, due not wholly to obstruction, but rather to an associated inflammatory change. In any case the acute pancreatitis is most commonly due to the presence of a gall-stone, and Opie<sup>81</sup> has recorded 32 such cases, every one of which was secondary to gall-stone.

Chronic pancreatitis is more common. In this series 24 cases were noted as having a small, hard pancreas, which was considered at operation to be a chronic pancreatitis. Most commonly this condition is limited to the head of the pancreas, and thus according to Opie<sup>82</sup> does not as a rule lead to glycosuria. Among this series there were three showing glycosuria. In one of them, which has been recorded by Mr. Mansell Moullin,<sup>61</sup> the glycosuria entirely disappeared after removal of the calculus.

Symptoms: As already noted in two cases calculi were found in the common duct with no symptoms pointing to their presence here. In the majority of cases, however, there is definite previous history of calculi in the bladder or of attacks of colic and jaundice pointing to their passage down the ducts. Of the 75 cases of calculi impacted in the common duct, in this series, there were 73 in which colic and jaundice had been present.

The jaundice sets in soon after the onset of colic, and within a day or two is very marked. If the stone becomes impacted it generally persists, but may be very variable,

probably owing to a certain amount of the pent-up bile making its escape around the calculus. With this jaundice there is more or less aching pain in the right hypochondrium, and in the early stages the liver is often felt to be enlarged. During the course of the condition the patient is very liable to exacerbations of severe pain, during which the jaundice is greatly increased and the enlargement and tenderness of the liver become more marked. With this jaundice there is the customary itching of the skin. In some few cases this irritability may appear in advance of the jaundice.

The amount of bile in the stools and urine will vary with the jaundice. In many cases the patient will notice that the stools have been white or clay-colored with the more acute attacks, but have regained their normal appearance during the intervals.

Charcot<sup>18</sup> first pointed out that with calculi in the common duct there was very commonly intermittent fever. In some cases this may simply be a sharp rise of temperature with a subsequent rapid fall, resembling that of a malarial attack. In other cases there may be slight shivering followed by sweating, or in the more severe types there is a definite rigor. Budd<sup>15</sup> has pointed out the close resemblance of this condition to urinary fever and inferred that both were nervous in origin. Like the urinary condition they are, however, almost certainly due to toxic absorption. These febrile attacks are seen almost constantly with exacerbations of pain and jaundice mentioned above. Of these 75 cases, 58 were noted as showing one or other of the above types of febrile attack.

As pointed out by Moynihan<sup>74</sup> and Fenger<sup>20</sup> loss of weight is one of the most marked and characteristic symptoms of impaction of a calculus in the common duct, and it must not therefore be regarded as evidence of obstruction from malignant disease. In this series 21 cases were noted as being markedly wasted.

### VII. *Carcinoma of the Gall-bladder.*

Carcinoma of the gall-bladder is not an infrequent complication of gall-stones, although there is considerable varia-

tion in the statistics given by different observers. Thus Slade,<sup>99</sup> out of 33 cases of gall-stones examined post mortem, found 16 in which the condition had been treated by operation. Of these, 56 per cent. were complicated by carcinoma. Hale White<sup>111</sup> and Ticehurst<sup>104</sup> found that of 333 cases of gall-stones at Guy's Hospital 45 had primary carcinoma of the gall-bladder. Riedel,<sup>91</sup> on the other hand, found primary carcinoma in only 28 per cent. of all cases of gall-stones. In this series they were even less frequent. Among the 409 cases there were only 18 showing definite carcinoma.

Carcinoma is, however, very frequently associated with calculus. Thus Zenker<sup>115</sup> found them in 85 per cent. of the cases of carcinoma, Courvoisier<sup>20</sup> in 91 per cent., whilst Janowski<sup>47</sup> found calculi in every one of his 40 cases. That the carcinoma is secondary to the calculi, and not the calculi to the carcinoma, is shown by the fact that Siegert<sup>116</sup> found calculi in 94 out of 99 cases of primary carcinoma, but in only 2 out of 13 secondary cases. In many cases of primary carcinoma there is, however, a long previous history distinctive of gall-stones. Thus in these 18 cases, there were 7 giving a history extending back over  $2\frac{1}{2}$  years; in 2 it was over 5 years, and in 2, over 20 years.

Candler<sup>18</sup> finds that gall-stones are more frequent in lunatics, being found in 14.13 per cent. among 2228 post-mortems, thus supporting the figures of Beadles,<sup>8</sup> who found them in 27 per cent. of the females and in 5 per cent. of the males dying at Colney Hatch Asylum, and of Warnock<sup>113</sup> who found them present in 50 per cent. of the females and in 11 per cent. of the males dying at Peckham House Asylum. Among them, however, there is apparently no relative increase in the frequency of carcinoma. Among Candler's 315 cases of gall-stones only two had a definite primary carcinoma.

Of greater importance than the above question is the frequency of carcinoma in the gall-bladder after the calculi have been removed, for if this be a common complication it will be a strong point in favor of removing every diseased gall-bladder. This condition seems, however, to be very unusual. Among this series there were only three such cases,

one of which has been fully reported by Mr. Lett;<sup>53</sup> in the other two the carcinoma appeared over one year after the first operation. Very few of these cases are to be found in the literature; one, however, was fully recorded by Knaggs.<sup>50</sup>

In the majority of cases the carcinoma is of a columnar or cuboidal-celled variety; in certain cases, however, the nature of the epithelium may be changed apparently owing to the chronic inflammatory condition, and a squamous-celled carcinoma may thus arise. Fütterer<sup>34</sup> has collected 13 cases of this variety. In this series of 18 cases none were noted as being squamous-celled.

In conclusion I must acknowledge my great indebtedness to the members of the surgical staff of the London Hospital for granting me permission to use the statistics of their cases in the compilation of this thesis.

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# A DOUBLE GALL-BLADDER REMOVED BY OPERATION.

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WHILE several cases have been recorded in which the fundus of the gall-bladder was bifid and its cavity separated into two for a portion of its length, I have only been able to discover one in which there were two complete cavities each possessing its own cystic duct. This specimen was found post mortem.<sup>1</sup> The following is, I believe, the first instance in which a double gall-bladder has been removed at operation.

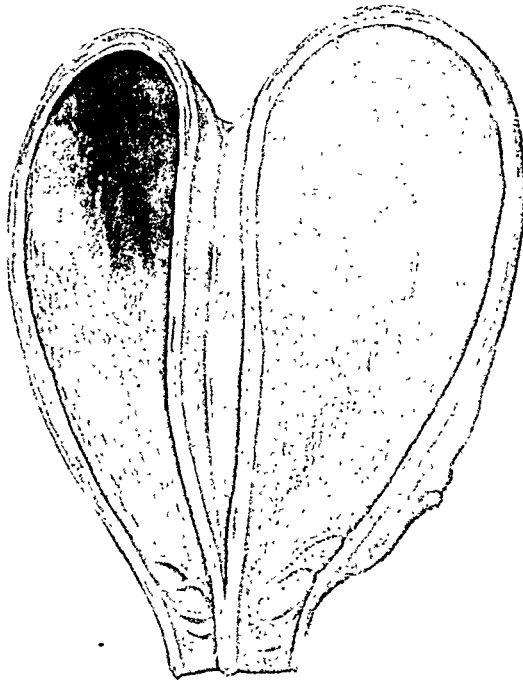
J. A., a woman of twenty-five, was admitted into the London Hospital under my care in July, 1910, with the following history: As long as she can remember she has had pain half an hour after food, in attacks of about a month's duration. The pain starts in the right hypochondrium, passes to the right shoulder, and is relieved by belching. In December, 1909, she was roused one morning in the early hours by a severe attack of colicky pain starting in the right hypochondrium. It doubled her up, and was accompanied by sweating and retching; a few days later she had a similar attack. She has had none since then, but her "indigestion" has been very bad. No history of enteric.

On examination slight, deep tenderness was present in the gall-bladder region. I believed her to be suffering from cholelithiasis, and accordingly operated on July 20, 1910. On opening the abdomen through the right rectus muscle, I found a distended gall-bladder which I could not empty. On tracing the cystic duct downwards to discover the cause of the obstruction, I came upon a firm nodule which I took at first to be a calculus. As it was apparently firmly impacted, I cut through the peritoneum covering the duct and discovered that the supposed calculus was a thickening in its wall about three-quarters of an inch from its junction

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<sup>1</sup> Purser: British Medical Journal, 1886, vol. ii, p. 1102.

FIG. 1.



Double gall-bladder removed by operation. Specimen in Museum of Royal College of Surgeons of England (No. 561.31).



with the common bile-duct. I ligatured and divided the duct and then found that I could not strip up the gall-bladder in the usual way, and the duct tore just above the nodule in the attempt. On further dissection I found another duct, which I ligatured and divided, covered the stump with peritoneum and closed the belly.

On examining the specimen <sup>2</sup> the two ducts were at once evident, and closer examination revealed another sac above and completely concealed by the distended lower one. On dissection (vide figure) two complete gall-bladders were evident, joined only along a narrow portion of their circumference. The larger one contained thick bile-stained mucus, the smaller thin bile. On examining the portion of cystic duct belonging to the larger gall-bladder, I found it patent at its common duct end; at the site of the nodule its lumen was a little increased in size and ulcerated as if from the lodgement of a calculus. Above this it appeared to be obliterated.

Microscopic examination showed the nodule to be composed of fibrous tissue with glands resembling Brunner's glands; below this the appearance of the duct was normal.

The cause of the distention of the gall-bladder seems to have been a fibrous stricture of the duct. Whether this was due to inflammation of the aberrant Brunner's glands or to the temporary lodgement of a calculus there is no means of knowing. I think the former hypothesis the more probable.

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<sup>2</sup> It is now in the Museum of the Royal College of Surgeons of England (Number 561.31).

## PRIMARY OVARIAN PREGNANCY.

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WITH the possible exception of abdominal pregnancy, primary ovarian gestation is the rarest of all forms of pregnancy. Many cases have been reported as ovarian which were probably tubo-ovarian.<sup>1</sup> In 1878 Speigelberg<sup>2</sup> formulated certain conditions which must be fulfilled in order to justify a diagnosis of ovarian pregnancy. He demanded that (1) the tube on the affected side must be intact; (2) the fetal sac must occupy the position of the ovary; (3) it must be connected to the uterus by the utero-ovarian ligament, and (4) definite ovarian tissue should be found in the sac wall. Most of the gynæcological works have little or not anything to say on the topic. Williams<sup>3</sup> in his textbook has gone into the subject exhaustively. He demands that ovarian tissue must be found to be present at different and all places in the sac wall. The condition is important for the good reason which Norris<sup>1</sup> points out, that in certain cases of tubal or broad ligament pregnancy, the ovary may be found flattened out against the gestation sac and to a certain extent forming a portion of its wall. In addition to these requirements, the tube on the affected side should not only be intact, but should be microscopically free from any evidence of gestation. Etiology, impregnation and fertilization of the ovum in the Graafian follicle.

*Symptoms and Diagnosis.*—I know of no way or any tangible reason why any one should make a correct diagnosis of primary ovarian pregnancy. It is significant and sufficient only that a diagnosis of extra-uterine pregnancy exists. The symptoms are those of an extra-uterine pregnancy, with all the possibilities of a fatal termination unless the condition is decisively attended to. In fact, Croft's case lost her life from severe hemorrhage. It is with some hesitancy that one accepts a diagnosis of ovarian pregnancy. Especially is this true when one, after reporting an ovarian pregnancy, as proven by the author, is confronted while reading an author of a little later date by a critical doubt whether the case was a true ovarian pregnancy. It seems to me, however, that it is only fair to believe that the man who reports a case has

a better and more comprehensive understanding of the true picture which it presented than the man who, from a critical standpoint, judges only from the printed account of the case. While I believe that certain rules must be followed, still I am of the opinion that every man should be given credit for a true diagnosis on his own personal observation of the condition present, and that the burden of proof rests with the critic to prove beyond a doubt that the case, after being reported in the literature, is not an ovarian pregnancy but is, of a certainty, either some other anatomical pregnancy, or that no pregnancy existed as reported.

REPORT OF THE CASE.—Miss — age twenty, born in the United States, family history negative. Menstruated first at fourteen, regular lasting four or five days. Some pain, especially first day. Menstruated last April 12, 1908. Started flowing about June 14, 1908, continued to flow until sent to the hospital, June 28, 1908, for a curettement and a better examination under ether. The tip of the cervix was soft, the os patulous and bleeding. The uterus boggy, somewhat enlarged. A mass the size of a large orange was felt in the left side of the pelvis; right side free. Breasts somewhat enlarged, containing some colostrum.

Operation at Troy Hospital, June 28, 1908. Median incision; a mass of about the size of an average orange occupying the left ovary was delivered. The tube and ovarian mass was cut away. The right tube and ovary were apparently normal and were not touched. A chronically inflamed appendix was removed. On opening the ovarian mass a partly formed embryo, of about six weeks' development, was liberated. The tube was apparently normal and was not attached to the ovarian mass. The ovarian mass was not adherent to any surrounding structure.

*Pathological Report.*—Gestation sac contained ovarian tissue; tube normal, no evidence of impregnation found in the tube.

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# CONCERNING THE TREATMENT OF TUMORS OF THE URINARY BLADDER WITH THE OUDIN HIGH-FREQUENCY CURRENT.\*

BY EDWIN BEER, M.D.,

OF NEW YORK.

IN the May 28, 1910, issue of the *Journal of the Amer. Med. Assoc.*, I reported a new method of attacking vesical neoplasms, and mentioned the immediate effects seen in the two extensive primary tumors thus treated. In that preliminary report I promised to publish at some future date the full details of these cases. In this paper I wish to present these cases in some detail, calling attention to the end results, the greater part of a year having elapsed. I shall also avail myself of this opportunity to mention some corroborative experiences of others as well as of myself in this new therapeutic work.

CASE I.—Mrs. J. S., 81 years, Hungarian. On Feb. 24, 1910, admitted to Mt. Sinai Hospital, First Surgical Service.

*Past History.*—Menopause 31 years ago. Typhoid fever at 18 years.

*Present trouble* began two years ago with hæmaturia. During intervening period has had hæmaturia irregularly. At first less frequent, now more frequent. Hæmaturia at present has continued for a month. Between attacks she passes clear urine. During attacks there is increased frequency. Has had pains in both lumbar regions. Has lost weight. Has not passed gravel or calculi. Chief complaints, hæmaturia without pain, and loss of weight and strength.

*Physical Examination.*—Poorly nourished, very anæmic old woman. Lungs show signs of emphysema. Heart shows systolic murmur at the apex as well as at base. Pulse is high tensioned, vessels are sclerosed. Liver and spleen are negative. Right kidney is palpable. Hæmoglobin 23 per cent. Red blood-cells

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\* Read in part before the New York State Medical Society, April, 1911.



1,664,000. Urine is bloody in color, alkaline, 1022, moderate amount of albumin. Microscopically it is loaded with red blood-cells and white cells.

March 4, 1910: *Cystoscopy and treatment of tumor with high-frequency (Oudin) current introduced through catheterizing cystoscope.* A cauliflower tumor surrounded the position of the right ureteral meatus, extending well to the right towards the lateral wall. The villi were very exuberant, protruding approximately 2 cm. into the bladder's lumen. The shape of the growth was slightly ovoid and in size it was as large as a dollar piece, the main part of the growth being to the right of the right ureteral meatus and apparently sessile. The Oudin current—without resistance—applied at three points: two at the base, 15 seconds each, and one among the villi for 30 seconds, making one minute in all (Fig. 1).

March 6, 1910: Bleeding continues. Patient complains of burning on micturition; also of increased frequency.

March 7, 1910: *Second treatment for 2½ minutes through cystoscope.* The three points of application of March 4 are distinctly visible, the shorter applications as white necrotic areas, while the longer application shows a gray-black necrotic crypt, more than twice the size of the areas affected by the shorter applications. At the second treatment five points of application made for 30 seconds each, the electrode being buried among the villi. Marked formation of gas was noted and tumor tissue regularly becomes adherent and baked to electrode. The insulating rubber at tip of electrode regularly softens and melts, exposing the copper cable which necessitates withdrawal of electrode and cutting of same so as to make rubber flush with cable. No sparks visible. At this seance and in all subsequent ones the rheostat lever was placed vertically, allowing much less current to flow into the electrode than at first treatment, as I wished, naturally, to exercise every precaution.

March 9, 1910: *Third treatment lasting 3½ minutes, 30 seconds at each site.* The surface of most of growth is necrotic, and goodly sized pieces of dead tumor tissue break off readily and some were recovered for pathological examination. Applications made at seven points. Pieces of tumor became baked to electrode and were removed for microscopic examination. (Diagnosis papilloma. Impossible to say from small specimen whether

carcinoma is present in deeper layers.) During this treatment bleeding set in and by local application of the current it was controlled.

March 11, 1910: *Fourth treatment through cystoscope, 1½ minutes application of current.* As whole tumor seemed necrotic after the previous treatments aggregating seven minutes in all, the fourth treatment was very brief, lasting only 1½ minutes. Carbonized pieces of tumor came away after this treatment (Fig. 2). Patient still complains of bladder irritability. The trigone is reddened, whereas the mucosa of the rest of the bladder is normal. Urine is almost clear, and contains regularly pieces of necrotic tumor appearing as dead white débris.

March 17, 1910: *Fifth application lasting 1 minute*, made as a demonstration of method for Drs. Keyes and Barringer. The tumor is dead grayish white, and whole surface appears necrotic, so that large pieces can be broken off without bleeding. The extreme right pole of the tumor shows a small pink-red nodular area, flattened on the bladder wall. This was cauterized for 1 minute. Under the current the mass became black—carbonized—in spots and white in others. Loose pieces of tumor débris are seen lying on bladder floor.

March 17, 1910: Bladder irrigations begun to help separation of necrotic tissue and wash débris away. Urine is clear. No more blood.

March 26, 1910: Cystoscopy. The tumor has changed very much in appearance. It is smaller and much flatter. Between the necrotic villi that are still attached the deep red velvety mucosa is seen in many places. With Blum's snare and forceps large masses of necrotic tumor are readily torn away from the rest of the growth without causing any bleeding, exposing large areas of red bladder wall.

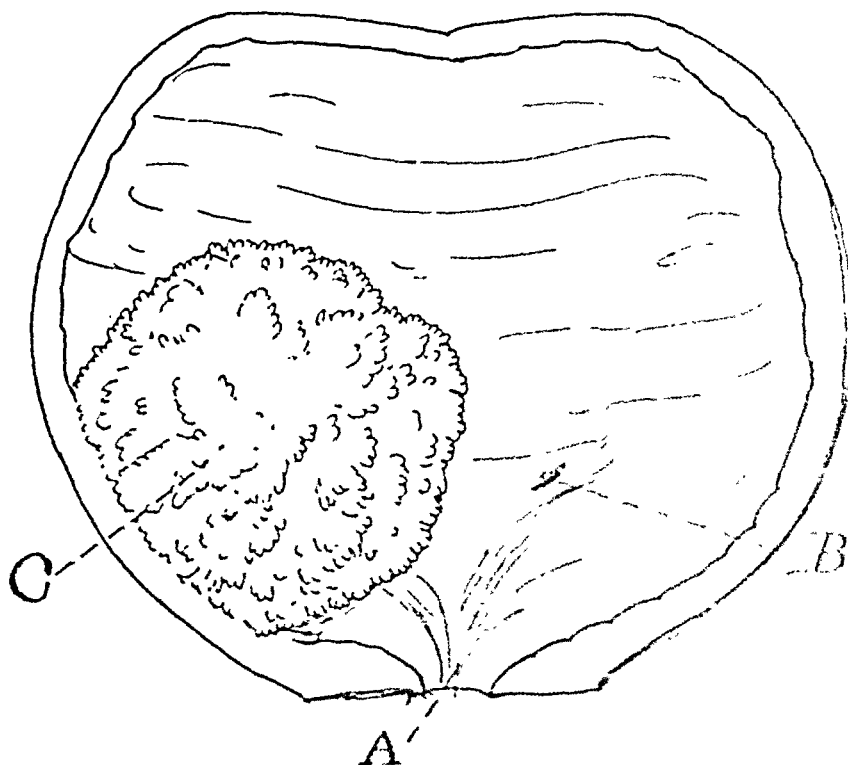
March 31, 1910: Cystoscopy. The appearance of the necrotic growth is much changed. Almost all the tumor has separated flush with the bladder mucosa and normal mucosa separates the two poles of the growth. In this area the normal ureteral meatus is now visible for the first time. It is apparent now that there were three distinct papillomata, growing in close proximity, separate at their bases and confluent superficially.

April 3, 1910. Cystoscopy. More of the necrotic tumor has separated, so that the ureteral meatus is even clearer and sur-



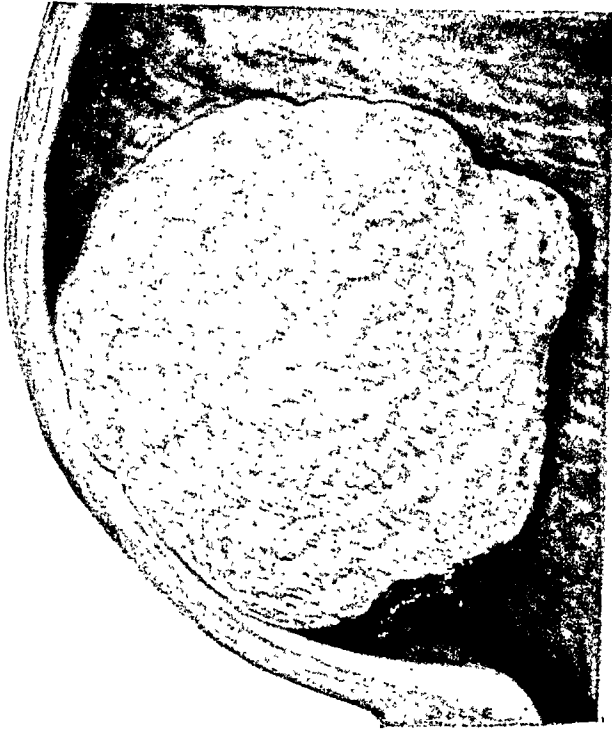
Case I.—F., 81 years, Feb., 1910. Two years' history of attack, of hematuria. The first attack began one month ago. Cystoscopy showed a large papillary growth, the base of which was surrounded by blood, surrounding the right ureter. The base was sessile and the villi were very coarse.

KEY TO FIG. 1.



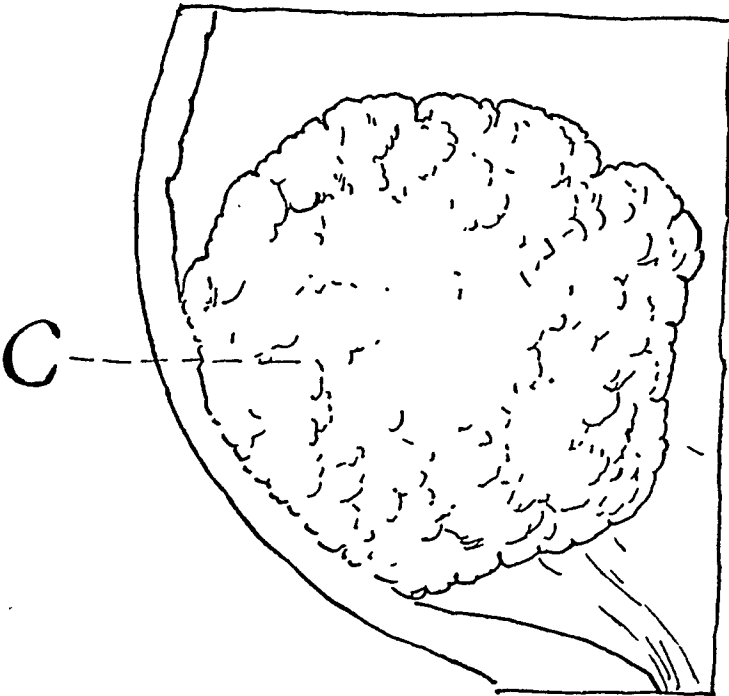
Shows the bladder wall, the mass, the stalk, and the ureter.

FIG. 2.



Case I (March 11, 1910).—The tumor having been treated for seven minutes has become totally necrotic. Microscopic diagnosis, based on recovered fragments, papilloma (impossible to say from specimen whether carcinoma is present in the deeper layers).

KEY TO FIG. 2.



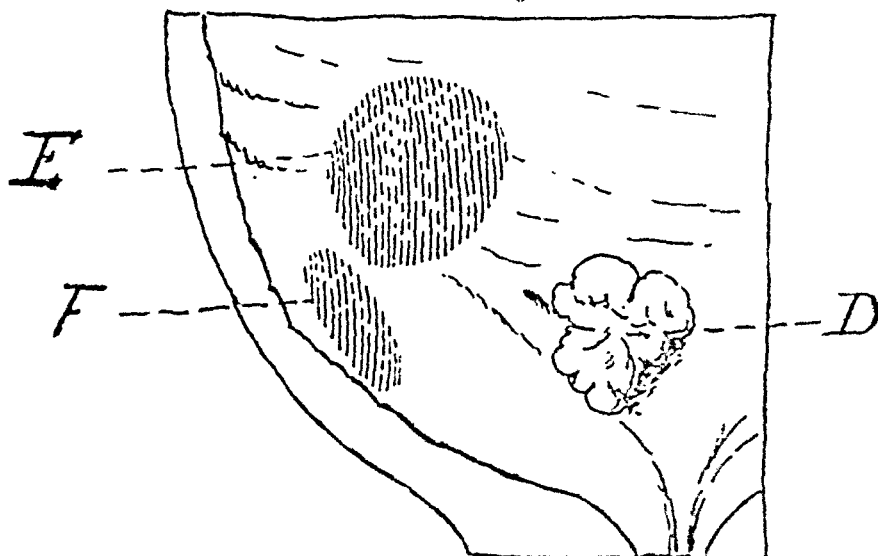
Shows the portion of bladder occupied by the growth C, which is now totally necrotic superficially, and the villi are no longer distinct.

FIG. 3.



Case I (April 6, 1910).—Most of the necrotic tumor has been thrown off. A small necrotic mass still adheres close to right ureter, which is patent to catheter No. 6, French. Well off near lateral wall, two small areas of apparently viable tumor. As the necrotic area separated completely, its base and the two more laterally placed, slightly raised, nodular areas were treated, and since May 11, 1910, patient's bladder shows no sign of previous disease.

KEY TO FIG. 3.



*D* still has adherent necrotic villi; *E* represents base of one of the original polypoid tumors; *F* represents base of the third papilloma.



rounded by healthy mucosa. The tumor base is more nearly level with the bladder, and what is left is in great part necrotic, though here and there distinct pinkish red areas (viable tumor ?) are seen. Mass D (Fig. 3), though totally necrotic, floats freely as a pedunculated piece of tissue still adherent to the bladder wall, mesial to the ureteral meatus, attached at its base.

April 6, 1910: Cystoscopy. The necrotic tissue is still separating and tumor base shows almost smooth mucosa with two small papillary areas partially covered with necrotic surfaces. These are situated at E and F in Fig. 3. After further separation of the slough the velvety red areas appeared. Mass D is also seen in this picture still attached to bladder wall.

April 9, 1910: Hæmoglobin is 65 per cent. Cystoscopy. Right ureter is catheterized, its lumen being uninfluenced by the removal of the growth, admitting readily No. 6 French. The necrotic mass D is smaller. When pushed by the catheter, mucosa is seen to encircle its base completely. To the right of the right ureter is normal mucosa except at the two spots or velvety red areas mentioned above, the bases of the two papillomata. These areas look spongy and, being slightly raised, I suspected that they were remnants of the tumor and treated them accordingly.

April 14, 1910: *Cystoscopy and high-frequency application* to the two flat masses E and F (Fig. 3) and to the base of D, the pedunculated necrotic mass having separated since the last examination. Applications to these areas lasted 5-15 seconds, aggregating  $1\frac{1}{4}$  minutes in all.

May 11, 1910: *Cystoscopy and high-frequency for  $1\frac{1}{2}$  minutes in all, 10-15 seconds each application.* The mucosa at site of D (Fig. 3) is absolutely normal. The two flat areas treated on April 14 are minute, and the one that received the more active cauterization has almost entirely disappeared. Both of these areas were again treated with high frequency. The rest of the bladder is absolutely normal.

After this treatment the patient returned to her home again, having been discharged shortly after the April 14 treatment.

June 1, 1910: *Cystoscopy and high-frequency for one minute.* The areas treated at the last session show small central sloughs surrounded by hemorrhagic mucosa. Though no definite signs of tumor are visible, these same areas were again treated.

June 29, 1910: Cystoscopy. No signs of tumor are visible. Two minute sloughs with radiating areas indicate areas cauterized at last session. As there were no suspicious spots no high-frequency treatment was given.

Aug. 10, 1910: Cystoscopy shows an absolutely normal bladder. No evidence of scar tissue. Mucous membrane is absolutely smooth and normal in every particular. (Demonstrated to Dr. A. V. Moschowitz.)

Nov. 15, 1910: Cystoscopy. Patient shows absolutely normal bladder. Slightly white mucosa (scar tissue?) at site of original growth and fine new formed vessels in this vicinity. Patient's urine is clear but there is still some increased frequency. (Demonstrated to Drs. Gerster and Lewisohn.)

Jan. 4, 1911: Cystoscopy shows normal bladder. (Demonstrated to Dr. Ware.) No sign of recurrence.

March 8, 1911: Cystoscopy shows normal bladder. (Demonstrated to Dr. Hyman.)

April 14, 1911: Cystoscopy shows absolutely normal bladder. (Demonstrated to Drs. Braasch, Herrick, and Hyman.)

July 7, 1911: Cystoscopy shows normal bladder.

*Remarks.*—In this patient of 81 years the condition was considered inoperable. The large papillary growth made up of three confluent tumors surrounded the right ureter. To remove the growth and reimplant the ureter would have been too severe a strain for this anæmic old woman. In 8 seances, aggregating  $13\frac{1}{4}$  minutes application of the Oudin current, the tumor was painlessly destroyed and the patient has been completely restored to health. There is no sign of recurrence.

CASE II.—Mrs. E. K., 66 years, German. On April 6, 1910, admitted to Mt. Sinai Hospital, First Surgical Service.

*Past History.*—Menopause 16 years ago. Had six children and three miscarriages.

*Present trouble* began 10 years ago. Symptoms at that time were hæmaturia lasting several weeks, increased frequency of urination, and burning on urination. Three years ago (June, 1907), had second attack of hæmaturia lasting three months. At this time I cystoscoped the patient at the German Hospital and found a papillary tumor the size of a hazel-nut a little to the left of the left ureteral meatus. The patient refused operation.



One year ago the third attack of hæmaturia began. This lasted two weeks. Nine weeks ago the present fourth attack began. The urine is very bloody and frequently contains large clots. Urination is every half hour during the daytime and three or four times at night. At present there is marked tenesmus. Patient has lost much weight and is steadily growing weaker. Two days ago she fainted.

*Physical Examination* (abbreviated).—Very feeble, very pale old woman, showing all the signs of a chronic progressive anæmia. Lungs, heart, liver, and spleen normal. Hæmoglobin 45 per cent. Urine is intensely red in color, resembles pure blood.

April 6, 1910: *Cystoscopy and 4 minutes' application of the high-frequency current (Oudin) to the papillary tumor.* As soon as the patient was admitted the treatment was instituted with the object of immediately controlling the excessive bleeding. Cystoscopy was almost impossible, and I doubt whether I could have located the growth without an air cystoscope, if I had not made notes of the position of the tumor three years earlier (Fig. 4). The active bleeding was uncontrolled by 1 per cent alum solution as well as by cold water. A view of the tumor was obtained only after a great deal of irrigation and filling of the bladder through the cystoscope while searching for the growth. As soon as it was located, the high-frequency current was applied at eight different points for thirty seconds at each. This controlled the bleeding almost completely at once. Even directly after the first application the bleeding was sufficiently controlled to allow me to get a fairly distinct picture of the growth, making subsequent applications much simpler.

The tumor was as large as a walnut. It was coarsely papillary and sessile. It lay 1.5 cm. to the left of the left ureteral meatus. It was stained with blood pigment. Specimen sent to pathological laboratory.

April 7, 1910: By this morning the urine was clear. There was no pain in bladder or urethra. No irritability. The specimen of tumor which had been removed, baked to electrode, shows papilloma (partly charred).

April 11, 1910: Urine has continued free of blood. *Cystoscopy (second) and high-frequency application for 4½ minutes.* The tumor is smaller, and many small fragments are lying free in the bladder, the anterior half of the growth is beginning to necrose whereas the posterior half is still pink in color. The

current was applied to this part, and at superficial points of application the tissue became white about the carbonized centre where the electrode established the contact. Frequently the tumor became so adherent to the electrode that, on drawing on same, it looked as if the whole tumor could be pulled from the bladder wall. This occasioned slight bleeding once, which was at once controlled by an application of the current. The rest of the bladder mucosa shows no sign of irritation.

April 13, 1910: Cystoscopy (third). The tumor is smaller and seems necrotic. The patient was then discharged with orders to return in four weeks, allowing this period for the process of sloughing to take place.

May 25, 1910: Owing to unfortunate circumstances treatment was discontinued up to date. There have been no symptoms referable to the tumor.

*Cystoscopy and high-frequency for 5 minutes (30 seconds application).* The tumor is about half its original size and its structure is very fleshy and very firm.

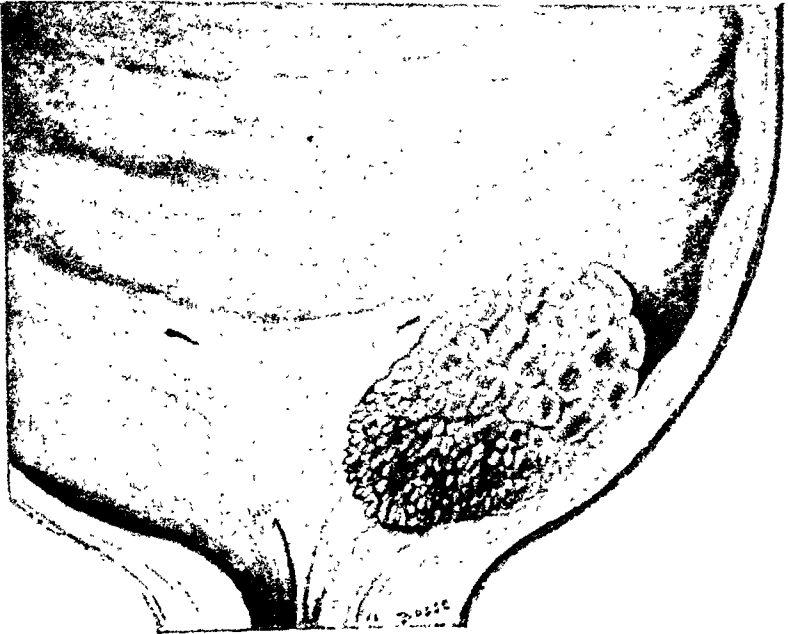
Fig. 5 represents the condition very admirably. Papillary outgrowths and thick villi have disappeared completely. This peculiar lobulated mass covered with mucosa seems to be a stage in the retrogression of the tumor. Attempts at cauterizing the remains of the "growth" caused some pain, perhaps owing to the fact that I was treating the thickened bladder wall, which, as stated, at times reacts in this way while the tumor is retrogressing. An extensive linear burning of a large part of the surface of the "growth" was made (Fig. 5).

June 8, 1910: *Cystoscopy and high-frequency for 30-40 seconds.* At the site of the tumor no projecting tissue is visible. There is a small linear slough marking the points of application of the current at last treatment. Adjacent to this a few brief applications were made aggregating in all about 30-40 seconds. Whether some minute vestiges of neoplastic tissue still persist despite the fact that they are not visible through the cystoscope, time alone can tell. Patient ordered to return in four weeks.

July 6, 1910. Cystoscopy shows no signs of recurrence. A minute slough is still attached at original site of tumor and from this the mucous membrane is thrown into radiating folds as if drawn by scar tissue formation into this condition.

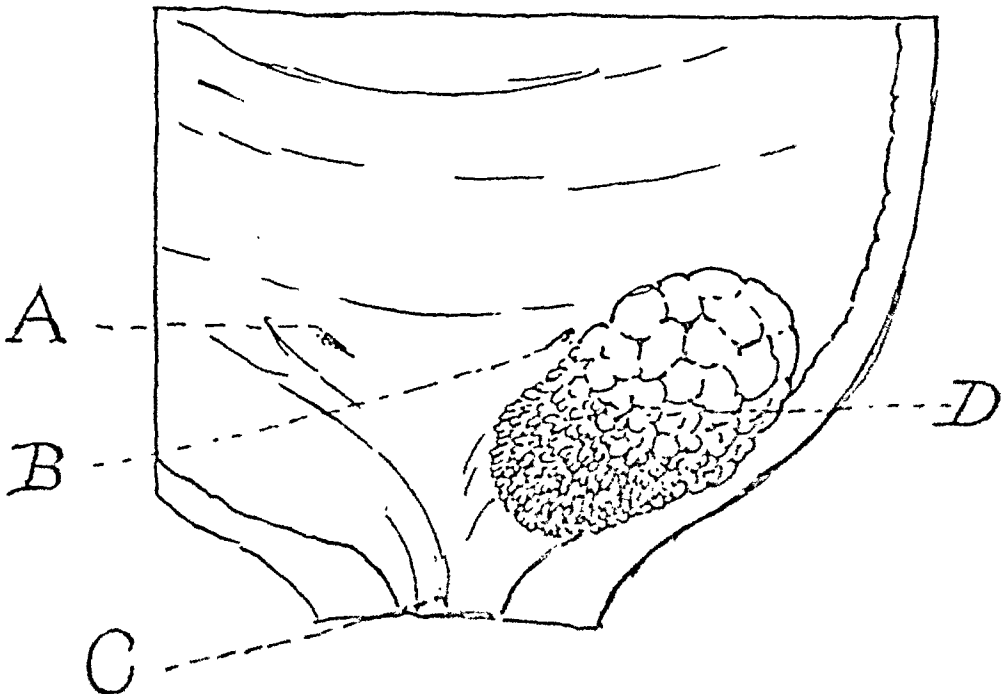
Aug. 31, 1910: Cystoscopy. Bladder is absolutely normal.

FIG. 4.



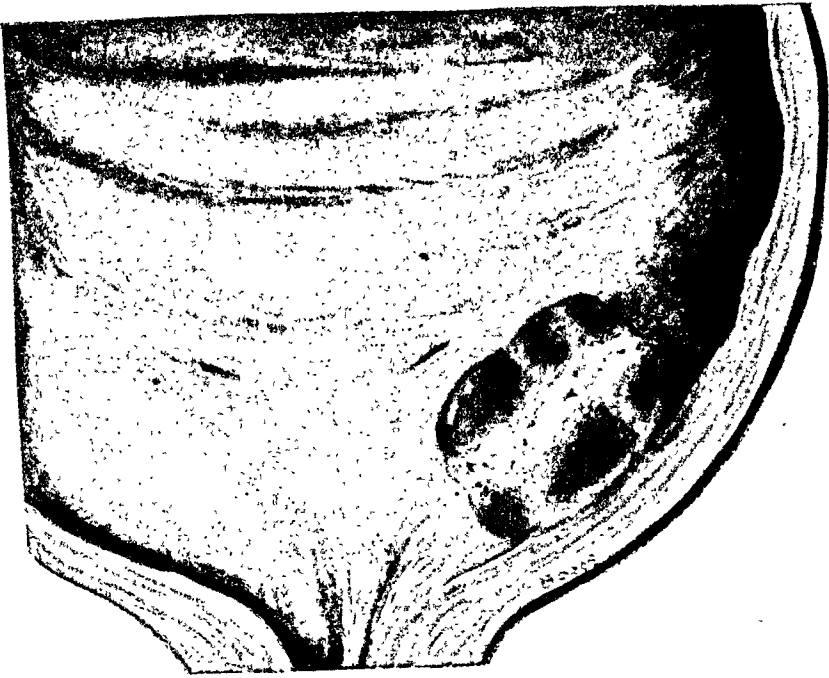
Case II.—F., 66 years, April, 1910. 'Ten years' history of attacks of hamaturia. Present attack began nine weeks ago and is very severe. At first treatment bleeding ceased, so that tumor could be readily seen in subsequent examinations. It was made up of fine villi and coarse bulbous papillae. It was well stained with imbibed blood and acrid. It was much flatter than the tumor of Case I.

KEY TO FIG. 4.



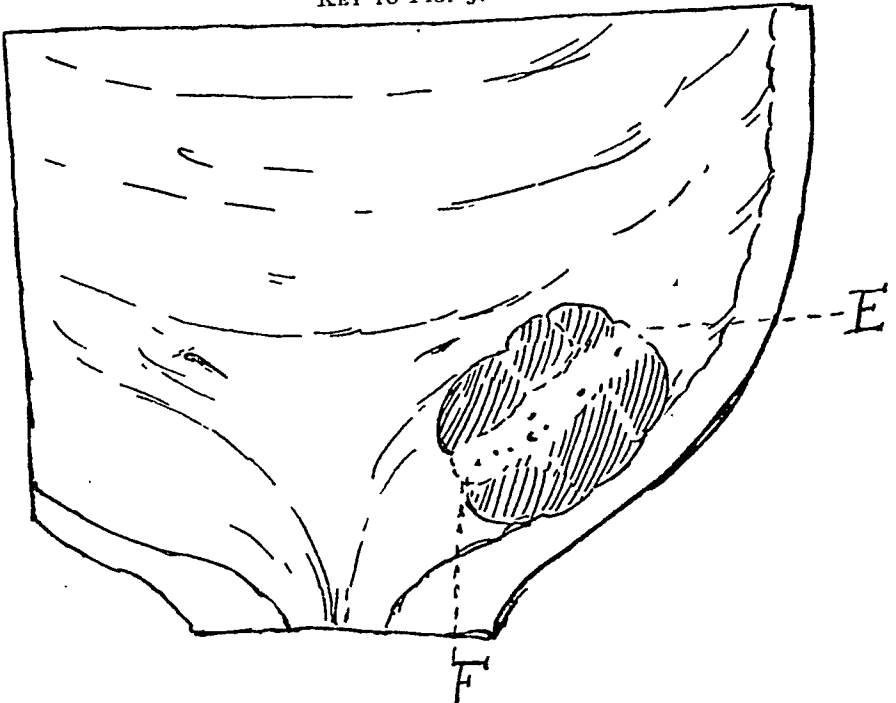
Bladder, showing wall of bladder, right ureter, left ureter, and bladder neck. (A) Right ureter, (B) left ureter, (C) bladder neck, (D) bladder, (E) ureter, (F) bladder neck.

FIG. 5.



Case II (May 25, 1910).—The tumor is less than half its original size. The necrotic villi, etc., have been thrown off, and a rather flat, lobulated, very firm mass remains at the site of the original growth. This, I believe, is an involution form or a stage in the retrogression of the original tumor. At that time I thought it rather hopeless to attempt to destroy such a solid growth, but nevertheless gave the patient five minutes' treatment, producing the irregular white and black eschar across its surface. On June 8, 1910, there was no sign of any previous tumor in the bladder, and since then there has been no recurrence.

KEY TO FIG. 5.



Shows marked change in appearance and size of the lesion. *E* to *F* shows line of application of the current as white scorching with black spots of charring.

(Demonstrated to Drs. A. V. Moschowitz, Lewisohn, and others.)

Oct. 26, 1910: Cystoscopy (21 weeks since last treatment). Bladder is absolutely normal.

Jan. 4, 1911: Cystoscopy shows absolutely normal bladder. (Demonstrated to Dr. Hyman.)

March 8, 1911: Cystoscopy shows absolutely normal bladder. (Demonstrated to Dr. Hyman.)

April 14, 1911: Cystoscopy shows absolutely normal bladder. (Demonstrated to Drs. Braasch, Herrick, and Hyman.)

July 7, 1911: Cystoscopy shows normal bladder.

*Remarks.*—In this patient there was a fair sized sessile growth which was bleeding very actively. The very first application and the very first treatment controlled this, so that the urine was absolutely clear twelve hours after the treatment and has remained so ever since. This growth was about half the size of the growth in Case I, and by means of the treatment employed in 4 seances aggregating 14 minutes' application the growth was totally destroyed. Had I understood the significance of the picture represented in Fig. 5, I probably would have dispensed with the last two seances and consequently have cured the patient after only 8½ minutes' treatment. This patient continues in the best of health. There is no sign of recurrence.

In addition to the above I have had eight other opportunities to study the effects of the Oudin current on vesical growths, and I shall report these experiences briefly at this time.

CASE III.—Male, 54 years. In this patient symptoms of tumor dated back 22 years. Examination showed the most extensive primary papillary growth that I have ever seen. The tumor stretched from the neck of the bladder across the trigone, over the left ureter and the left two-thirds of the trigone, thence up the left lateral and posterior walls to well above the equator, taking in between one-quarter and one-third of the whole bladder wall. This patient was difficult to treat, not only because of the great size of the growth but also on account of severe bleeding and of bladder irritability. In 9 seances aggregating 34 minutes' application of the current the whole tumor was destroyed and gradually thrown off in large and small pieces. The pa-

tient is in excellent health and has gained 32 pounds. Judging from the experiences in Cases I and II, this patient seems cured.

CASE IV.—Female, 67 years. Referred to me by Dr. S. Brickner. This patient had suffered for some years with painless hæmaturia. The first and only treatment was given during severe bleeding. The brief treatment had practically no effect on the bleeding, and while I was waiting for it to subside a little, so as to make inspection of the apparently very large growth more easy, four days after I had treated the patient she fell over dead while sitting at breakfast. During the previous days she had felt perfectly well, having been up in a chair most of the time.

Whether we are to connect this sudden death with the treatment or not is difficult to decide. No autopsy was granted, so that we cannot state whether death was due to a sudden hemorrhage in the brain or an embolism. The family of the patient had been told by the family physician that owing to her cardiac condition she would die suddenly, as she did. Be that however as it may, I suppose an embolism might arise from a bladder growth, and such an occurrence must be considered a possibility though very improbable, judging from all experience up to date. Cases V and VI had four papillomata, and in these the use of the high-frequency current was most effective in destroying the tumors. They responded just as well as the Cases I, II, and III, and appear to be well on the high road to complete and permanent cure.

*To recapitulate, therefore, I have treated successfully up to date five cases of primary papillary tumors of the bladder, aggregating 9 distinct tumors, with this new method, and judging from the results in Cases I and II, it seems clearly demonstrated that these cases can be cured definitely in the manner here described.*

In addition I have treated two cases of recurrent papillary tumor of the bladder. One case is still under treatment, and a large part of the very extensive growth has been thrown off. The original tumor was excised some years ago and was diagnosed as carcinoma by a competent pathologist. Whether

patient and conscientious treatment in this particular case will lead to a cure it is impossible to say up to date.

The other recurrent case could not be adequately treated, as the old suprapubic wound opened up and the patient gradually developed a fatal renal insufficiency. As the result of one treatment in this case, larger pieces of the papillary growth sloughed away, as in all the other cases. These two cases were the most difficult to treat, as their tumors were most extensive and could not be seen in their entirety with either the indirect or direct vision cystoscope. Both instruments had to be used in applying the current. Both cases illustrate the inefficiency of the suprapubic method, as well as the fact that many of these cases are worse off after such an attempt at removal than they are with their original growths (Cases VII, VIII).

Two undoubted cases of carcinoma of the non-papillary type I had an opportunity to treat. As was to be expected my results were negative. They were extensive growths, and as they were very firm I desisted very quickly (Cases IX, X).

*The Experiences of Others.*—It is most gratifying to find that a number of surgeons have already tested this new method and are satisfied with it. Dr. E. L. Keyes, Jr., has published his early experiences in the *American Journal of Surgery*, vol. xxiv, No. 7, July, 1910. Drs. L. Buerger and A. L. Wolbarst have published theirs in the *New York Medical Journal*, Oct. 29, 1910, and Dr. J. F. McCarthy has read of his results at several medical meetings.

Through the courtesy of these gentlemen and through that of Dr. C. Elsberg and Dr. M. Ware, I have been able to gather from the experience of all these surgeons a large number of papillary tumors of the bladder that have responded to the high-frequency treatment as satisfactorily as the cases I have detailed above *in extenso*. From correspondence with these surgeons who have treated in all 27 papillary growths, I see that their experiences coincide closely with my own and that they all prefer this simple method of attack to the older operative method. Whether most of these 27 tumors are permanently cured it is too early to say. Dr. Keyes writes that nine

tumors of his series he considers cured, such cures being verified by cystoscopic examinations in one case twelve months, in another nine months, in still another six months after destruction of the original papillomata. Of Dr. Buerger's cases, two controlled in the same way have remained well the greater part of a year also, whereas in another case, as in that of Dr. Elsberg, a new tumor developed in another part of the bladder. These metastases are responding, both gentlemen inform me, just as satisfactorily as the original growths.

*From all these observations based on the application of the high-frequency treatment as used in some 38 papillary growths, it must be evident to the most sceptical that in this new method we have raised a mighty rival to the older supra-pubic and to the transurethral operative cystoscopic methods. I believe that it will supplant previous methods, because of its far greater simplicity and its great effectiveness.*

*Technic and Dangers.*—A. The method of employing the Oudin current for the removal of intravesical neoplasm is the same as described in the May 28, 1910, issue of the *Journal of the American Medical Association* and subsequently in the *Zentrallblatt für Chirurgie*, No. 34, 1910. In the latter communication a mistake was made in stating that the spark gap in the muffler is approximately 25 cm. This should have read 0.25 cm.

The essential instruments for this therapy are: (1) a high-frequency machine with Oudin resonator,<sup>1</sup>; (2) a ca-

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<sup>1</sup> To produce the current essential to the therapy discussed in this paper, I have used the high-frequency apparatus manufactured by the Wappler firm. The Oudin current is derived from the resonator, and is unipolar, thus allowing of the use of only one intravesical electrode. The current oscillates very rapidly and is of very high voltage. The source of the original current may be the usual street current. If this does not alternate the high-frequency machine must be fitted with an alternator. The accompanying sketch (Fig. 6) taken from de Keating Hart (1908) shows diagrammatically how the Oudin current is generated from the street current.

NOTE.—Instead of the induction coil and interrupter the latest model instrument uses a closed magnetic field transformer ("step-up") which



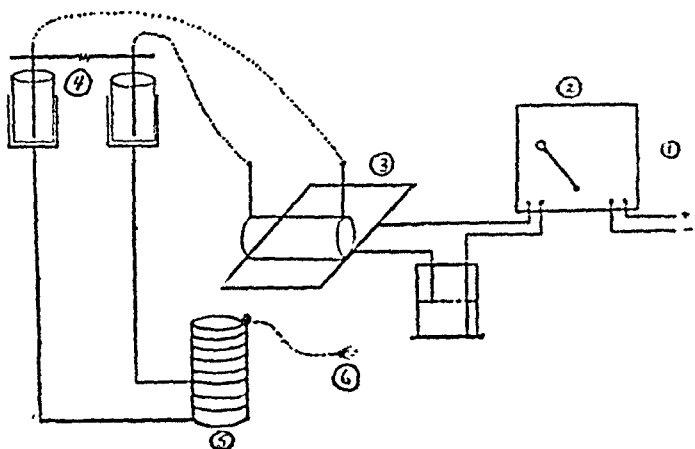
theterizing cystoscope; (3) a heavily insulated copper electrode.

After the bladder has been washed and then filled with distilled water, the cystoscope armed with the electrode is introduced. The electrode is pushed a short distance in amongst the villi and the current is allowed to play for 15-30 seconds at each application. The nearer the electrode ap-

gives more rapid oscillations and can be effectively employed in any room.

The Oudin current has been known for some fifteen years and has been used with varying success in a number of skin conditions. Of late it has been used in malignant disease by de Keating Hart. Almost all workers with this current have made use of a spark of varying length holding the electrode at some distance from the lesion and playing the sparks upon this. Early in my experimental work on skin warts, I saw that direct contact between the current and the electrode was much more

FIG. 6.



(1) represents source of current (street); (2) rheostat, meter, etc.; (3) induction coil and interrupter; (4) condenser and spark gap; (5) Oudin resonator and terminal; (6) electrode delivering the Oudin current.

effective in destroying the warts than when an air gap was maintained. The cauterizing effect of the current thus used can be easily demonstrated experimentally on a piece of raw meat immersed in water in a pus basin (non-insulated). The point of application of the electrode becomes rapidly white and in a few seconds the cauterization progresses to carbonization. While this takes place hydrogen is freely generated. A current of equal intensity applied through an air gap has no such effect. Moreover, according to the analyses made up to date, metallic copper appears to be regularly present in the tissues at some distance from the point of applica-

proaches the base of the growth the shorter should be the applications, lest the bladder wall be injured. Moreover if the electrode touches the bladder wall it causes pain, otherwise there is no pain. By making repeated applications at different spots the whole growth will be rapidly destroyed, and as it disintegrates it is voided in small pieces, as a rule. This process of separation in very large growths may extend over several months. As stated, I employed the Oudin current derived from a Wappler machine, usually placing the rheostat vertically, so that half the resistance was thrown into the circuit. If a stronger current seemed necessary I threw out the rheostat altogether. The spark gap in the muffler was made between one-eighth and one-quarter inches. Usually I employed a short gap.

As a rule, I employed the Nitze double catheter cystoscope. In one catheter tunnel I placed the electrode and to the other I attached a tube for irrigation. A direct cystoscope is useful in some cases, in others absolutely necessary.<sup>2</sup>

The electrode employed was a simple 6-ply copper wire thoroughly insulated and cut off squarely at the end. The end has to be pruned repeatedly as the rubber insulation melts during usage. This electrode I procured through the Wappler firm.

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tion when contact is made but not otherwise. Investigations along these lines are not concluded as yet. Up to date it would appear that the current as used in the treatment outlined in this paper has several activities in addition to being a powerful cautery. It is only fair to say that physicists have rather regularly denied this.

In view of the ready handling of the Oudin current and in view of its marked cauterizing effects, it will surely prove of great therapeutic use in a great variety of conditions, not only in the bladder and urethra. In these parts it has proven an ideal cautery in my hands. The applications can be made under the guidance of the eye through cystoscope or urethroscope, and small or large areas can be cauterized as each case demands. In papillomatosis of the larynx I feel sure from experience in one extensive case, it will prove as useful as in the similar vesical condition.

<sup>2</sup> Of late I have used the Bransford-Lewis cystoscope, as it allows of direct and indirect vision applications at one sitting without withdrawing the instrument.

*Applications.*—The applications were made directly to the growth, the electrode being pushed a short distance in among the villi under the guidance of the eye, and then the current was turned on at various points for 15-30 seconds, the bladder being distended with distilled water. In my early seances I made the treatments rather short. The longest total applications that I have used at one seance aggregated 10 minutes, 30 seconds at 20 different spots. This was an enormous tumor and so long an application surely is not necessary except in such cases. A total of 3-5 minutes at one sitting will suffice usually. A few days later it should be repeated, provided any viable tumor tissue is visible, as at the original sitting it is impossible to determine how extensively one has destroyed the growth. Treatments are discontinued as soon as the whole growth appears necrotic. The sloughs are allowed to separate spontaneously or helped along with bladder irrigations. After the base is thus exposed (after 3 weeks or longer) it is treated as were the original outgrowths.

*Effects.*—The immediate visible effects are very striking. No spark is seen if the electrode is placed properly among the villi. A spark may be seen if the surface is flat and prevents the electrode from burying itself. While the current is on, gas<sup>3</sup> is freely generated and bubbles out of the growth. If the point of application is superficial, one can readily see blanching of the tissues about the point of application, and at the spot where the electrode's point rested the tissues are blackened. As the electrode is withdrawn from the growth, very frequently it is found to be adherent to the villi, and as it is pulled upon, the whole tumor moves with the electrode which finally comes away with a small mass of tumor tissue baked to its tip. This is only rarely followed by bleeding, and a re-application of the current at the same spot usually controls this.

After the patient has expelled the necrotic tumor the base may require further brief applications to destroy any tumor

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<sup>3</sup>Outside of the body this gas produced in similar manner appears to be hydrogen.

residue as stated above. The patients should be carefully cystoscoped from time to time, and if any suspicious areas are visible they should be destroyed at the same sitting. In this way we can hope to obtain excellent and permanent results.

B. No method which is so destructive of tumor tissue can be absolutely free from danger. The patient that died some four days after treatment may have died of an embolus, and this possibility, I suppose, should be borne in mind, irrespective of whether death in this particular case was due to this cause or not. This is, however, a remote danger judging from all experiences with this method up to date.

Another danger that one can imagine is severe burning or perhaps perforation of the bladder wall. With care this should be avoided. As one is working under the guidance of the eye, one ought to know exactly where the electrode is situated before turning on the current and by adhering to this fundamental point no such damage should be inflicted.

*History of the Method and Nomenclature.*—In the early part of 1909, after purchasing in Vienna the intravesical set of operating instruments made by Victor Blum, for use through the ordinary Nitze catheterizing cystoscope, my thoughts were turned to procuring an intravesical cautery that could be used in the same manner as the Blum instruments. In Vienna I could find no such cautery, and on my return to America I decided to look into the question of using high-frequency current for this purpose, having previously had some experience with its cauterizing effects on skin warts. I immediately took the matter up with the Wappler firm, where I had bought my high-frequency apparatus, and was thoroughly disappointed when Mr. R. Wappler, the electrical expert of that firm, told me I could not use these currents as I wished, because, first of all, an air gap between the tumor and the electrode was essential, and, second, the current would burn out my cystoscopes. Others, whom I consulted, members of the profession who had more experience with these currents in dermatological conditions, told me that Mr. Wappler's views as to the necessity of having an air gap were absolutely cor-

rect. Despite this information I ordered through the Wappler firm a very thoroughly insulated copper (6-ply) electrode so that I might experiment with these currents and test the validity of these expert views. I wasted some time in trying to fit the end of the electrode with a cup-shaped depression which would retain a small amount of air even under water and thus give me a small air gap. In treating warts under water I quickly found that no such gap was essential and that the warts could be readily removed by direct application of the electrode and current to the warts. I then tested my cystoscopes (Nitze-type catheterizing-Loewenstein make) and found that they carried the current without in any way interfering with the illumination. I then treated skin warts through the cystoscope under water and obtained most satisfactory results. I was then ready to employ the method in bladder tumors as originally conceived.

In the meanwhile the over-zealousness and enthusiasm of a member of the firm, through which I obtained my original copper electrode, allowed him to unbosom the method to a number of colleagues in New York City. To how many he spoke I do not know. Several gentlemen informed me of this fact, which led me to make my preliminary report in May, 1910, whereas it had always been my intention not to write this subject up until I had observed the cases for at least six months after the disappearance of the growths. Fortunately the technic and the results mentioned in my preliminary report, based as they were on experimental work and clinical observations, were perfectly satisfactory, and subsequent experience has not led me to make any changes, so that in this more extensive paper I have nothing to retract from my original statements.

In proposing a new method of treatment it is always well to call it by some short name. As yet I have not been able to think of any name which properly characterizes this method of treatment, as the title of this paper shows. The high-frequency current of Oudin is used, applied through a copper (heavily insulated) electrode under water, and to express all

of that in one word seems more difficult than to cure a case by this method. Others (Keyes, Buerger, McCarthy) have spoken of the method as fulguration, to which I have repeatedly taken exception as the method is not the same as fulguration (de Keating-Hart, Pozzi). By fulguration is meant the method of using high-frequency currents as suggested by de Keating-Hart, "sideration" being the name originally employed by this experimenter. Pozzi suggested that it be called fulguration from the resemblance of the long spark to lightning. As de Keating-Hart says,<sup>4</sup> "Let it suffice to recall that this method consists in an electrosurgical operation divided into two stages. The first stage consists of the operative removal of the tumor practiced if not extensively (when that is impossible) at least to the limit of the apparent boundaries of the disease, and including therein metastases and infected glands. Then, in the second stage, long and powerful sparkings of great frequency and high tension are applied to the wound thus made." Another striking difference is evident when we contemplate the effects of the current used as indicated above intravesically through water, and compare them with de Keating-Hart's observations. He says,<sup>5</sup> "This method (fulguration) seems to act, not on the neoplasm, but on the soil in which it grows." "Mice cancers, when fulgurated, then removed, and reimplanted in healthy mice, developed afresh, under conditions identical with those of grafts that had not been exposed to the spark; the neoplastic cell (not destroyed directly by the electric discharge) was then in no way attacked by it as regarded its viability." On the other hand, in the intravesical method described in this paper, the growth is directly destroyed.

I believe these citations ought to make clear that the method here advanced should not be called fulguration. If the method is properly used one seldom sees sparking, and as fulguration refers definitely to the long lightning-like sparks employed in the manner described above by de Keating-Hart,

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<sup>4</sup> Interstate Medical Journal, June, 1910.

<sup>5</sup> Ibidem.

and is an excellent descriptive term for a fixed procedure, it would be confusing to apply that term to the therapeutic method that I am here describing, and to call this new method of attacking intravesical neoplasms fulguration.

The current of Oudin has been used for some 15 years in removing surface growths, and the only novel feature of my method is the use of these currents under water and in the urinary bladder. The resemblance that it bears to the treatment of surface neoplasms is much greater than that which it bears to de Keating-Hart's technic, and it is my belief that for all these reasons it should not be confounded with the very recent development known technically as fulguration.

*Therapy Used at Present in Bladder Tumors, Benign and Malign.*—In this field during recent years there has been great discord, almost all surgeons favoring the transvesical route, a few pleading for the transperitoneal. Only two or three came out warmly for the transurethral route and the operating cystoscope. Of late a new school has come to the fore, saying "Hands off!" (Posner).

If we are face to face with a malignant neoplasm, there can be no question as to what procedure should be adopted. The transperitoneal operation recently strongly recommended by Dr. C. Mayo alone promises any result. If this cannot be done, owing to the patient's general condition, palliation and not a cure is the best that can be expected unless the tumor is very small. Under such conditions the Oudin current may produce a cure.

When, however, we come to the papillary growths, which probably are benign in the great majority of cases despite the fact that Rokitansky named them *carcinomata villosa* and despite the teaching of the Guyon school which considers them malignant because they recur so regularly after attempted transvesical excision, then we enter a much debated field. Nitze has shown that he can obtain much better results with the operating cystoscope than anybody has obtained by transvesical suprapubic operation, and he and Sonnenburg\* only

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\* Bergmann, Bruns, and Mikulicz: *Handbuch d. Prakt. Chirurgie*. 1907.

recently declared that after such transvesical procedures recurrence is the rule. Cathelin in a recent paper admits at least 50 per cent. recurrences after the suprapubic operation.<sup>7</sup> He sides with Nitze and the operating cystoscope. Whether the results by the transperitoneal route will approach those obtained by Nitze we cannot state as yet. Even if they should be vastly superior to those obtained by the suprapubic transvesical route, and just why they should be it is difficult to figure out, it must be evident that the danger of this operation is much greater than that of the Nitze procedure, and that the transurethral route is and will be the more ideal in every way. The only obstacle to the wide introduction of this technic has been the great difficulty of manipulating the rather complicated armamentarium and the very frequent sittings that some cases require as well as the occasional post-operative severe hemorrhages.

If, then, as it appears at present, the transurethral route gives the best results and is the least risky so far as immediate outcome is concerned, it is evident that the new method advocated in this paper must measure up with the method of Nitze and the operating cystoscope.

It is too early to say that the method used in the cases reported will give results as good as those reported by Nitze. It must, however, be evident that the technic here described is much simpler than that employed by Nitze, and it would appear from all the experiences gathered up to date that it will rival Nitze's method when end results are compared. The great simplicity of this new method, the rapidity with which large growths are destroyed, the ease with which any trained cystoscopist can carry out the necessary manipulations, all suggest to me that it is the method of the future in the treatment of benign growths in the urinary bladder.

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<sup>7</sup> Cathelin *Folia Urologica* No. 6, 1910.



## APPROXIMATION OF THE ENDS OF FRAGMENTS IN FRACTURES WITH CONTRACTION OF THE ATTACHED MUSCLES.

BY P. B. MAGNUSON, M.D.,  
OF CHICAGO.

MUCH attention has been called recently to the operative treatment of fractures. It has come to be looked upon with favor by able surgeons even in simple fractures of humerus and femur. As to the advisability of this, we will not discuss the subject here; it is simply to advance a method of handling the fractured bone so that the fragments may be placed in apposition with the least possible danger of infection.

While engaged in experimental work on lengthening shortened bones of the leg<sup>1</sup> it was necessary to devise some method of stretching the soft tissues and at the same time holding the fragments steady enough to insert the ivory screws<sup>2</sup> used in this operation. At that time we used hooks clamped into the ends of each fragment, the upper one being fastened to the upper end of the table by a wire, the lower one attached to a wire run over a pulley at the foot of the table to which weights were attached. This gave a strong, steady pull which rapidly stretched the soft tissues without injuring them. It kept the fragments in line and enabled the operator to manipulate the bone to his perfect satisfaction.

Adapting this method to use on old ununited fractures, where the ends of the fragments were far past each other, we found it most efficient and very simple.

A pad is placed in the axilla or groin as the case may be, and over this pad and encircling the limb is a broad piece of heavy ticking which is tied to the upper leg or end of the table. Another broad piece of ticking is placed flat above the knee or

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<sup>1</sup> Lengthening Shortened Bones of the Leg by Operation, University of Pennsylvania Med. Bull., May, 1908.

<sup>2</sup> *Ibid.*

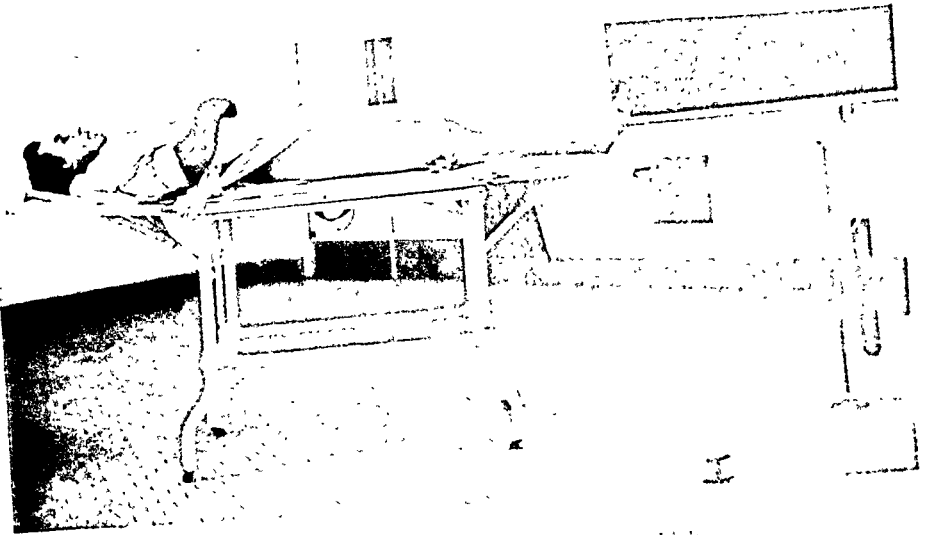
elbow-joint on the side opposite the large blood-vessels and brought around the limb, being tied in a clove-hitch on the opposite side. A wire is attached to the loop at the knot and this is run down to a pulley extended from the lower end of the table by an iron rod clamped to the table at one end and supported by a standard, which may be raised and lowered to suit requirements at the other. To the end of the wire we attached window weights—as many as are required (Fig. 1). In the operations on the femur we have used from fifty to seventy-five pounds, accomplishing the necessary stretching in from ten to twenty minutes.

ILLUSTRATIVE CASE.—Mr. F. H., aged forty-six. Occupation, switchman. Sustained fracture of left femur in November, 1910. He was an alcoholic, and his attending physician was unable to restrain him, with the result that the fragments had overlapped about three and one-half inches, and were buried in the muscles above and below, at an angle to one another. The patient was brought to Dr. S. C. Plummer for operation on March 12, 1911.

An incision was made in the thigh and the bony bridges cut away, the extension apparatus being applied when patient was placed on the operating table. As soon as the bony unions were cut the fragments drew into line, and inside of fifteen minutes the ends were in apposition without any muscular effort on the part of the surgeon. An assistant manipulated the lower leg at the direction of the operator, and the fragments were adjusted without touching the bone with the hands, which is such an important thing not to do in this sort of surgical procedure.

Dr. Edward Martin, of Philadelphia, has devised some very ingenious instruments for grasping and holding the ends of the fragments, if this becomes necessary. We have found the ticking loop to be very satisfactory, however, in most cases, and believe this acts with the least amount of traumatism to the parts, is simple and only stretches the soft parts immediately connected with the broken shaft, saving trauma to joints and ligaments above and below.

FIG. 1.



Showing method of stretching muscles of thigh.



## SIMPLE FRACTURE OF THE PISIFORM BONE.

BY R. B. DEANE, M.D., C.M. (McGILL),

OF CALGARY, ALBERTA, CANADA.

As simple fractures of the carpus, with the possible exception of the scaphoid, are of extreme rarity, the following case may be of some interest:

In February, 1911, the patient, a muscular young man, aged twenty-three, fell one story down an elevator shaft and in addition to some minor cuts and bruises on other parts of the body, believed he had sprained his right wrist, for which he consulted me within 15 minutes of the accident.

The pain in the joint was trifling and the appearance and movements of the wrist practically normal, but upon examination I was able to elicit crepitus over the pisiform bone and even to hear it at a distance of three feet when the patient rotated his forearm. This gave the patient the impression that there was something "loose," as he termed it, in the joint.

I skiagraphed the joint immediately, and the fracture was plainly visible in both supine and prone positions, even to slight stripping of the periosteum at distal end of fracture in the former position.

The fracture I presume to have been caused by sudden violent hyperextension of the wrist-joint with the hand adducted, the pull of the flexor carpi ulnaris being strong enough to cause a transverse fracture of the pisiform bone, the conditions reminding one of the part played by the quadriceps extensor in producing a transverse break of the patella with the knee flexed.

As one would expect from the slight separation of the pisiform fragments, the results as to treatment both in regard to function and appearance are perfect.

# GERMICIDAL AND OSMOTIC ACTIONS OF PICRIC ACID.

BY O. W. H. MITCHELL, M.D.,

OF COLUMBIA, MISSOURI.

(From the Pathological Laboratory, University of Missouri.)

PICRIC acid has for a number of years been recognized as a very useful drug in the treatment of burns, particularly. Its use was based mainly on its power of coagulating albumins.

Recently Ehrenfried<sup>1</sup> has published his results regarding the germicidal action of aqueous picric acid solutions and the results obtained by the clinical application of the same. He used a saturated aqueous solution, which is 1.2 per cent. if the C. P. crystallized picric acid is dissolved in boiling water. His experiments showed this solution to be approximately fifty times more germicidal than 1 per cent phenol solution. The method used was to dip glass rods into a bouillon culture of recently isolated strains of *Staphylococcus aureus* and *Bacillus pyocyaneus*, allowing them to dry for one hour, exposing them to the action of the different germicidal solutions, washing off the excess of the solution in sterile bouillon, and then making agar streaks.

That these results might be confirmed, similar experiments were undertaken in this laboratory. For comparative germicidal action, solutions of bichloride of mercury were used and also the combined solutions of picric acid and bichloride.

The findings with the glass rod method are as follows: *B. pyocyaneus* was killed after a one and one-half minute exposure in the 0.5 per cent. aqueous picric acid solution and after a one minute exposure in a 1 per cent. aqueous picric acid solution. In the mercuric bichloride solutions no growth was obtained after a minute exposure. In the solutions containing picric acid and mercuric bichloride no growths were obtained after a half minute exposure.

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<sup>1</sup> Journal A. M. A., vol. lvi, Feb., 1911.

*B. typhosus* was killed after an exposure of one and a half minutes in a 0.5 per cent aqueous picric acid solution and in one minute in a 1 per cent. aqueous picric acid solution. In 1:1000 mercuric bichloride solution no growth was obtained after a half minute and in a 1:2000 mercuric bichloride solution the organisms were killed in one minute.

Ehrenfried found *B. pyocyaneus* killed in from one to two minutes' exposure in a 1.2 per cent aqueous solution of picric acid, and the results obtained in this laboratory are confirmatory.

Such a method of testing the germicidal actions of solutions do not warrant the most reliable conclusions as to their clinical application.

Recently Seelig and Gould<sup>2</sup> described a very interesting method of testing the germicidal action of various solutions by osmosis through different tissues of living animals. Rabbits and guinea pigs were used for this purpose. The procedure is as follows: The animal is anesthetized and the hair clipped from the skin of the abdomen. If the skin is to be used it is carefully dissected with sterile instruments, leaving it attached at one end. It is then stretched over a small container in which the solution to be tested is placed. A sterile glass rod clamped firmly and attached to a ring stand is lowered until it pushes the skin into the solution. As this is done a bouillon culture is poured into the depression around the rod and the time noted. Cultures are then made at regular intervals from the culture which was poured into the depression around the glass rod. This same procedure is used with all tissues, great care, however, must be taken when using the mesentery as small perforations are easily made. Another precaution is to, as nearly as possible, get the same amount of surface of the tissue used in contact with the solution in the container and also to use the same amount of culture around the glass rod. If these are not the same the amount of solution penetrating would be different in different experiments and the concentra-

<sup>2</sup> Surgery, Gynecology and Obstetrics, vol. XII, March, 1911.

tion of the penetrating solution would vary with the amount of solution around the glass rod.

By this method the following results were obtained. No germicidal action was shown after sixty minutes' exposure when the skin and abdominal muscles were used. When the mesentery was used *B. typhosus* was killed in 15 minutes with a 1 per cent. picric acid solution, in 11 minutes with a 1 per cent. alcoholic solution, and in 15 minutes with 95 per cent. alcohol.

The bouillon culture with the aqueous and alcoholic solutions of picric acid became distinctly yellow in at least a minute when mesentery was used in the above experiments. The culture showed no picric acid coloration when the skin and abdominal muscles were used.

Seelig and Gould call attention to the rapidity of osmosis and the germicidal action of alcohol in a 95 per cent. solution. This undoubtedly accounts for the different results between the aqueous and alcoholic solutions of picric acid.

Through the kindness of Dr. F. G. Nifong, picric acid solutions have been employed for cleansing the skin of the abdomen of all his patients operated on at the Parker Memorial Hospital. The abdomen is shaved, washed with soap and water, and then the picric acid solution applied. This is done the night previous to the operation. Immediately before opening the abdomen, this same procedure is again practised. This procedure has been used in 19 cases. Smears are taken before the last application. In no case has a growth been obtained. At first aqueous solutions were used, but now a 1 per cent alcoholic solution is employed.

It was noted that after a prolonged operation the surgeon's fingers would be colored yellow, when they wore rubber gloves. It was found on experimentation that aqueous solutions will pass through rubber in from 30 minutes to several days, varying with the thickness of the rubber tissue employed.

In none of the cases have any untoward symptoms been noted. The urine of only one patient showed a transient albuminuria, and this cannot be ascribed to the absorption of the



picric acid solution employed any more than to the ether employed for anæsthesia.

Dr. A. W. Kampschmidt reports, personally, very favorable results from the application of a  $\frac{1}{2}$  per cent. aqueous solution of picric acid in cases of chronic gonorrhœal urethritis.

#### CONCLUSIONS.

Picric acid is a strong germicide.

No untoward results occur from the application of a 1 per cent. aqueous or alcoholic solution to large areas of the skin.

Picric acid has strong osmotic powers.

In aqueous solutions it is capable of passing through rubber tissue.

The substance deserves closer study and a wider clinical application.

# TRANSACTIONS

OF THE

## NEW YORK SURGICAL SOCIETY.

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*Clinical Meeting, held at St. Luke's Hospital, April 12, 1911.*

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

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### EXCISION OF THE RECTUM AND VAGINA FOR CANCER.

DR. ROBERT ABBE presented a woman, 40 years old, who came to him more than seven years ago with the rectum obstructed by a bleeding and foul-discharging adenocarcinoma, extending as far as the finger could reach, and bulging the adherent vaginal wall forward. An abdominal incision permitted exploration and drawing out the sigmoid, which was divided and both ends inverted. The distal end was dropped into the peritoneum, and the proximal end was drawn out through a second small, intermuscular incision at the usual site of an inguinal colostomy.

Two weeks later, the rectum and posterior vaginal wall were removed by an incision completely through the perineum, extending around the anus and back to the sacrum. The coccyx was excised and the perineum again restored by suture continuous with the posterior wound. No more perfect sequel could be imagined: the patient had one normal movement daily from her side, and no compress excepting a flat handkerchief was needed, without other pressure than her clothing, to enable her to conduct her arduous house duties without discomfort.

The case was shown to illustrate a patient in perfect health seven years after extirpation of cancer of the rectum and vaginal wall, with admirable functional working of an inguinal anus.

### ADENOCARCINOMA OF THE RECTUM: PERINEAL EXCISION.

DR. HENRY H. M. LYLE presented a man, 53 years old, who was admitted to the hospital on February 27, 1911. He gave a history of pain in the rectum for the past three months. This was most marked during and after defecation. He had had hemorrhoids for years, and of late these had increased in size and now protruded from the rectum. There had been more or

less constant bleeding during the past two weeks. He had recently been confined to bed, and had lost a good deal of flesh and strength.

Examination showed a fungating mass protruding from the anus. The mass extended upwards for a distance of two inches. A section, which was removed and examined microscopically, showed it to be an adenocarcinoma.

Operation, March 1, 1911: This consisted of a perineal resection of the anal portion of the rectum, with the formation of a gluteal anus. The wound healed by primary union. The patient has good rectal control.

DR. HOWARD LILIENTHAL said that in connection with these cases of artificial anus he desired to call attention to a paper which he published in the *ANNALS OF SURGERY* (September, 1910) in which he described a method which involved sewing the gut to the peritoneal and posterior rectus sheath, and then twisting it after the method of Gersuny and sewing it to the aponeurosis. He had followed this plan in a number of cases, and the resulting artificial anus was even watertight. Mayo had also tried it with good results.

#### ENORMOUS GOITRE, WITH GRAVES'S DISEASE: PERMANENT HEALTH SIX YEARS AFTER CURE FOLLOWING RADIUM TREATMENT.

DR. R. W. ABBE presented a woman who had suffered from exhausting symptoms of Graves's disease for a year and a half; to wit, palpitation, suffocation on lying down, tachycardia (pulse 120), trembling, progressive feebleness, anorexia and perspiration, enormous increase in the thyroid, with dyspnoea, inability to ascend stairs, and with moderate exophthalmus.

As the goitre was hopelessly inoperable, and as some claims had been put forth for the Röntgen ray treatment of goitre, as well as for operative work on the cervical sympathetic ganglia, Dr. Abbe conceived the idea of radiating the neck and goitre by inserting a strong radium tube into the goitre for twenty-four hours. No other treatment was adopted excepting occasional enemata and the use of Carlsbad salts.

The goitre began to subside in two weeks, and in eight weeks was so far reduced as to be nearly normal. The patient was soon restored to health, and during the following six months was able to walk many miles daily, to play tennis and resume her

usual occupations. She had remained in perfect health for six years, with no return of the goitre.

Dr. Abbe, in reply to a question as to whether he had employed the radium treatment in other cases of exophthalmic goitre, said he had treated many cases with this remedy; most of them had showed distinct improvement, and some were cured, as was this one. He had selected this case for presentation on account of the enormous size of the goitre.

#### RESECTION OF THE COLON FOR CANCER; LATERAL ANASTOMOSIS.

DR. R. W. ABBE showed four of these cases, and the specimen from a fifth (operated on the previous day). In all of these there had been an extirpation of an adenocarcinoma of the colon, with resection of the ileocaecal valve and from eight to eighteen inches of colon, followed always by lateral anastomosis. In all but one of these cases the adjacent lymph-glands were enlarged, and on removal showed only inflammatory hyperplasia. There were no recurrences. One patient was in perfect health two and a half years after operation.

#### SARCOMA OF THE PAROTID TREATED BY RADIUM.

DR. R. W. ABBE presented a man, who five years ago was on the point of giving up his profession as a lawyer owing to a parotid tumor the size of a goose egg cut lengthwise, which raised the ear and filled the parotid fossa. In order to illustrate the size of the growth, Dr. Abbe showed a colored plaster cast of the condition before and after treatment, which consisted of the insertion into the tumor of tubes of radium. Its rapid reduction and diminished size had been sustained by occasional treatments at long intervals, with the result that there remained now an inert mass.

Portions of the tumor had been punched out prior to the insertion of the radium tubes, and had been reported to show all the qualities of parotid sarcoma excepting cartilage.

Dr. Abbe said he had demonstrated the specific action of radium against parotid sarcoma in numerous other cases.

#### LARGE PRIMARY CARCINOMA OF THE LIVER.

DR. ABBE showed this rare case. The patient was a man with an abdominal growth of four years' duration, with associated lumbar and hypochondriac pain, which had obliged him to

give up his work two years ago. Dr. Abbe made an exploratory incision and found a massive, lobulated tumor of the entire left lobe of the liver, so that its size was much greater than that of the normal right half. The right half of the liver was pushed well into the right hypochondrium, but it was absolutely normal in color, and uninvolved. The left lobe was composed of a conglomerate series of masses of different shades of tawny brown—none as dark as liver. A piece was excised for examination and submitted to Dr. Wood, who pronounced it a true, primary adenocarcinoma of the liver. A fair estimate of the weight of the growth would be between four and five pounds. The surface was left exposed in the wound, and packed down upon with sterile gauze.

After a few days radium treatment was begun as follows, in the hope that the growth might be affected, as many other hypertrophic adenomatous structures were, by it: Eight long celluloid tubes of pencil size were thrust far into the tumor in different directions. Into two of these tubes strong radium in glass was inserted (100 mg. of pure French radium, strength 2,000,000x). Every six hours one of the empty tubes ("dummies," as Dr. Abbe called them), was removed and replaced by a radium one, and thus the mass was equally radiumized for about 40 hours. The wound was then allowed to granulate, and soon healed.

Following this the patient was greatly improved and returned to work. He had continued in good health and had worked for the past two years, excepting for one interval of a month when he returned to the hospital for a second treatment to try and further reduce the mass, which had, on the whole, not materially changed in total bulk, excepting in the central area for a hand's breadth, where it had shrunken so as to make a saucer-shaped concavity.

In this case, Dr. Abbe said, the radium treatment seemed to have arrested the growth and restored the patient to working health.

#### INOPERABLE LARGE CAVERNOUS ANGIOMA OF THE PAROTID REGION TREATED WITH RADIUM.

DR. R. W. ABBE presented a young girl who came under his care for an apparent soft cyst of the parotid region, about the size of half an orange, and quite deforming. An operation revealed

a purple angioma with a thin capsule, over which branches of the facial nerve were traced. Extreme hemorrhage followed any attempt to enter the mass, while ignipuncture seemed likely to imperil the facial nerve.

An incision was made into the mass, with instant blocking by a tube containing 60 mg. of pure radium bromide. This was surrounded by packing and left in the centre of the angioma for one day. The wound was then allowed to heal, and the patient went home. There was a sharp radium reaction four weeks later, about the usual time, but of great severity. There was induration, heat and tenderness, with malaise, chills and a temperature of  $106.5^{\circ}$ , which for three days gave rise to some anxiety. Then the mass began to shrink, and she gradually made an excellent recovery, with restoration of the side of the face to its present perfect appearance.

The pathological change in this case, Dr. Abbe said, was a cellular one rather than a thrombophlebitis, as there was no extension to the neighboring veins. The toxic febrile record occurred not infrequently in extensive radiumization, as in mammary or other glandular treatments, and the speaker said he attributed it to be the result of some liberated chemical products, due to tissue changes, which was short of absolute necrosis, but which was invariably followed by atrophy and fibroid changes favorable to cure.

#### EXTREME HYPERTROPHY OF THE LEFT HALF OF THE TONGUE TREATED WITH RADIUM.

DR. R. W. ABBE presented a young man of 25 who since he was thirteen years of age had had an increasing growth of the left half of the tongue with more or less constant pain and attacks of bleeding. The involved portion of the tongue had grown to be three times its normal size, and presented a papillary growth of its surface as well as the deeper tissues, due to angiomatous and lymphoid hyperplasia. The normal midline of the tongue was pushed far to the opposite side, and the overtopping growth was purple and glazed in appearance, with clots and a tough secretion of offensive odor. The pain had caused him to give up his work. His speech was very thick and swallowing was difficult. There was occasional severe hemorrhage.

The case seemed to be a typical one of hypertrophic glossitis, with excessive angioma and lymphangiectasis, in which good

might be expected to follow radiumization. He was given a few short applications of a plaque coated with twenty-five milligrams of pure French radium, and covered by a rubber dam for protection, which was no barrier to the penetrating electrons of radium. This treatment produced a rapid effect. Two weeks of discomfort followed, after which the process began to retrograde, and now, a year later, the condition was more than half cured, with every promise of complete recovery by slow, patient and occasional treatment. No other surgical expedient could possibly have accomplished such admirable work.

Dr. Abbe, in concluding his series of cases treated with radium, said he had only exhibited a very few of the intensely interesting effects of radium in unusual surgical conditions, and had purposely omitted showing any of the ordinary cases of superficial basal-cell epithelioma which invariably yielded to radium, and of which he had cured hundreds.

There was one other type of round-celled sarcoma which he had expected to show, but the patient was unable to come. The case had been already reported in print, and up to the present time had remained perfectly cured of a rather large sarcoma of the lower eyelid, seven years after treatment with radium. Remarkable as it might seem, one could not tell to-day by appearance on which eye the tumor grew, so perfect was the restoration of every tissue. A series of colored plaster casts of this case was shown, illustrating the stages of treatment before, during, and after radium cure, extending over a period of only eight weeks. The growth had existed one year, and had failed to respond to Röntgen ray or other treatment.

#### EPITHELIOMA OF THE BLADDER.

DR. CHARLES L. GIBSON presented a man, 71 years old, who was admitted to St. Luke's Hospital on February 20, 1907, suffering from marked hæmaturia. Cystoscopic examination showed a small growth situated just above the left ureter. Under ether anæsthesia the growth was removed by suprapubic cystotomy, including the underlying mucous membrane. The bladder was closed by inversion of the opening, with tube drainage, according to the method recommended some years ago by Dr. Gibson. Convalescence was uneventful. All leakage had ceased at the end of a week, and the patient returned home in two weeks, entirely cured, and without wearing any kind of dressing. Since

the operation he had remained absolutely free from urinary and other symptoms, and might be considered cured. Microscopic examination of the growth showed it to be an epithelioma.

#### OLD POTT'S FRACTURE; OSTEOTOMY AND BONE PLATES.

DR. CHARLES L. GIBSON presented a man, 28 years old, a machinist by occupation. A year ago he injured his right foot, sustaining a Pott's fracture. The result of treatment left the foot in a disabled condition, with backward displacement, eversion and abduction, causing practically total disability.

Under ether anæsthesia, an osteotomy of the fibula at the site of the fracture was done, as well as an osteotomy of the internal malleolus. Following these the foot could be brought back into satisfactory position. The section of the malleolus was maintained in proper position by a three-hole Lane plate. Healing of the wound was satisfactory and at the end of a month the foot was in good position. At the present time, however, since the patient had been walking about and using his foot, some recurrence of the deformity was apparently taking place. There was some abduction and the result was not perfectly satisfactory.

#### FRACTURE OF THE FOREARM TREATED WITH LANE PLATES.

DR. GIBSON showed a boy, thirteen years old, who was admitted to St. Luke's Hospital on October 27, 1910. A week previously he had sustained a fracture of both bones of the right forearm at the midpoint. Under ether anæsthesia an incision was made over the fracture line in each bone, and a four-hole Lane plate applied. Healing was satisfactory, and the patient left the hospital in two weeks. He now had a perfect result: the arm was straight, there was no deformity, and functionally it was as good as before the injury, including complete pronation and supination.

#### MIKULICZ RUBBER DAM DRAIN.

DR. GIBSON showed a boy convalescing from an operation for appendicitis in order to illustrate the use of rubber dam drainage. He had now used this device for about twelve years in cases where he had occasion to insert a large tampon, particularly in the abdomen. It was his custom to make the outer layer of the tampon of the rubber dam used by dentists. This could be easily sterilized, and in its centre a few holes were cut. The method



employed was to introduce the rubber dam at the bottom of the cavity, maintain it in position, and put in as much gauze for drainage as seemed needful. The gauze drained well, capillarity sucking up the fluids through the holes cut in the rubber tissue. The removal of the gauze could be done without disturbing the rubber dam, thereby securing the patient's comfort, and diminishing largely the inconvenience and danger of the adhesions of the gauze to the adominal contents. By this method one could do all necessary dressing, renewing the gauze, in some cases, without giving the patient any pain or discomfort.

#### AMPUTATION AT THE KNEE FOR OSTEOSARCOMA.

DR. GIBSON presented a married woman, 25 years old, with the following history: She was admitted to St. Luke's Hospital in December, 1909, complaining of a swelling in the middle of the left leg. There was the history of a blow six years ago, and the swelling was first noticed four years before her admission.

An X-ray was taken, which showed a moderate enlargement of the tibia at its mid-point. In the centre of this swelling was a cavity the-size of a twenty-five-cent piece, resembling a focus of osteomyelitis. At operation, after uncovering the cavity, some pultaceous material was evacuated. The surrounding bone, however, showed no signs of necrosis. The pathological report was not final, the condition being regarded either as an osteosarcoma or a productive osteitis. The wound healed well, but the patient soon had a return of the pain and re-entered the hospital in February, 1900.

Another X-ray picture taken at this time showed a process somewhat similar to the first one, but larger. Believing that he was dealing with a malignant growth, the tibia, for a space of two and a half inches, was resected, including the periosteum. It was expected eventually to complete the operation by some form of bone plastic, but as the patient was pregnant at the time, it was deferred indefinitely. She obtained only temporary relief from the operation, and returned in December, 1910, showing some enlargement at the site of the operation, attended with pain, spontaneous and on pressure.

The X-ray showed a certain amount of bony production at the site of the old operation, and a rather dubious appearance which might be interpreted as a recurrence of the growth. The patient's pain increased, requiring considerable morphine, and it was felt

that the time had come to institute more radical measures. On March 21 disarticulation was performed at the knee. The wound healed and the patient was relieved of all pain.

Macroscopical examination: The specimen consisted of the left leg, amputated at the knee-joint. On the anterior aspect, about 25 cm. below the joint, there was an annular scar about  $2 \times 4$  cm. Just external to this there was an incision 18 cm. long, which disclosed a tumor of the tibia, forming an oval mass about  $5 \times 6$  cm. This was covered by fibrous tissue which had been split open to expose the structure of the new growth. This was made up of bony material, but in the form of granules or calcified material instead of a solid mass. Below and external, and on a level with the lower border of this mass was a second oval growth  $2 \times 1.5$  cm., apparently within a tendon. It was as hard as bone.

Microscopical examination: Sections showed rather loose calcareous tissue made up of ill-defined cells, some of which, however, showed distinctly staining, fair-sized oval nuclei.

#### EMERGENCY PROSTATECTOMY.

DR. GIBSON presented a man, 91 years old, who was admitted to St. Luke's Hospital on November 13, 1905. He had been an inmate of an institution for the blind for some years. When admitted to the hospital he was suffering from extravasation of urine, due to forced and unsuccessful attempts to pass instruments for the relief of retention, the result of prostatic hypertrophy. On account of the false passages, no instruments could be passed into the bladder.

Under ether anæsthesia a perineal section, without a guide, was performed, evacuating much blood and urine from the infiltrated perineal tissues. Having in mind the patient's helplessness on account of his blindness, it was thought wise to attempt the risk of relieving the condition, so a prostatectomy was undertaken. Owing to the friability of the infiltrated tissues, the prostate as a whole was speedily delivered, although unintentionally. Notwithstanding the patient's advanced years and his feeble condition, he made a good recovery, and was discharged entirely healed in two and a half months. He now enjoyed good health for a man of his advanced years. He had imperfect control of his urine, which was to be expected after the removal of the prostate *en masse*.

## URETERAL CALCULUS: EXTRAPERITONEAL REMOVAL.

DR. LYLE showed a boy, thirteen years old, who since he was four years of age had suffered from recurrent attacks of pain in the right flank. The pain came on gradually; it did not radiate, reaching its maximum intensity in five or six hours and then gradually subsiding. The patient had vomited once or twice during severe attacks. Recently the attacks had become more frequent and severe and of longer duration. The urine had been cloudy at times; there was no history of blood in the urine. Four years ago, at another hospital, a diagnosis of acute appendicitis was made and the appendix was removed, but the patient's symptoms persisted.

Upon examination it was found that the lower pole of the right kidney was palpable. There were no areas of hyperæsthesia; no tenderness nor rigidity. An X-ray plate showed a shadow in the course of the lower third of the right ureter.

An extraperitoneal exposure of the right ureter was made by means of a semilunar incision, which corresponded to a prolongation of the right limb of a Pfannenstiël incision. The ureter was lifted into the wound by means of a blunt hook, and a vertical incision was made over the calculus. This proved to be a mulberry-like stone about the size of a bean, of a mottled brown and white color. This portion of the ureter was dilated to the size of the forefinger, and the stone could be pushed up and down for a distance of an inch and a half, but no further. The stone was extracted by forceps, and the ureteral wound was closed by a continuous gut suture. The abdominal wound was closed by layer suture, with a small rubber drain inserted at the lower angle. The patient made an uninterrupted recovery.

## OPERATION FOR CARCINOMA OF THE CERVIX; NO RECURRENCE AFTER NINE YEARS.

DR. H. M. LYLE presented a woman, 48 years old, who had been operated on nine years ago for an adenocarcinoma of the cervix. A complete hysterectomy, with removal of the adjacent glands, had been done. There were no evidences of recurrence up to the present time.

## PERFORATING DUODENAL ULCER.

DR. HENRY H. M. LYLE presented a man, 32 years old, who was admitted to St. Luke's Hospital on February 18, 1911. His

family history was negative, and he gave no previous history of stomach or intestinal trouble.

On admission he stated that for the past three days he had suffered from diarrhoea, which had kept him from work. On the fourth day he returned to work and ate a hearty lunch. Three hours prior to admission he was seized with a violent, cramp-like pain in the epigastrium; he felt faint, and vomited a small amount of clear fluid. There was no history of a chill. His temperature on admission was  $101.4^{\circ}$ ; pulse, 108. An examination of the blood showed 16,700 white cells, with 90 per cent. of polymorphonuclears. The urine was negative. He did not appear to be very sick and complained of very little pain. The abdomen was contracted, rigid, and moderately tender, the tenderness being most pronounced above McBurney's point.

The case was regarded as one of acute appendicitis, with spreading peritonitis, or possibly a subacute gastric ulcer. A vertical incision was made at the outer border of the right rectus, and upon opening the peritoneum, a thin, seropurulent fluid gushed out. The appendix was found to be normal. A second incision was then made over the region of the stomach, and upon incising the peritoneum, the same seropurulent fluid was encountered. The stomach was normal. On the upper, posterior aspect of the duodenum, about three-quarters of an inch distal to the pylorus, a pin-point perforation was found. This had apparently been temporarily sealed by the liver, which showed a fresh, fibrinous patch. There were no adhesions, and no induration about the ulcer. The perforation was closed with a purse-string suture, and the suture line reinforced by tacking a portion of the gastrohepatic omentum over it. Both abdominal wounds were closed without drainage. The patient made an uninterrupted recovery.

Dr. Lyle said that he believed this to be a true, acute ulcer of the duodenum, as there was no history of any previous stomach trouble, and there was an absence of adhesions and induration.

#### INITIS PLASTICA OF THE STOMACH (BRINTON) (CIRRHOSIS OF THE STOMACH): GASTROJEJUNOSTOMY.

DR. LYLE presented a woman, 40 years old, who was admitted to St. Luke's Hospital, in the service of Dr. Theodore C. Janeway, on June 11, 1907, and transferred to the surgical side on July 23 following. The patient's father had kidney trouble

and rheumatism, and three of his children had rheumatism, two with cardiac complications.

The patient had her first attack of rheumatism when she was nineteen years old, which kept her in bed one month. Seven years later she had a second attack, with cardiac complications, of eight months' duration. She had a third attack two years later, and her last attack had occurred in January, 1907. This was followed by otitis media, which lasted four weeks. She had frequent attacks of nocturnal dyspnoea, which compelled her to sit up in bed to breathe, and she suffered from pain, palpitation, dizziness and syncope. Her menses were irregular and painful. There was no history of syphilis.

Five days prior to admission the patient had sharp, cramp-like pains in the left lumbar and inguinal regions, radiating downward and inward into the thigh. These pains persisted for three days; then they disappeared, to reappear on the second day after. She felt nauseated, but did not vomit. The attacks came on at irregular intervals and seemed to bear no relation to the taking of food. She complained of tenderness at a point just to the left of the umbilicus.

A stomach analysis, made on June 4, 1907, gave a total acidity of 56; free hydrochloric acid, 20; no lactic acid; no Boas-Oppler bacilli; no blood. A blood examination showed 11,532 leucocytes; polynuclears, 74 per cent.; lymphocytes, 26 per cent.; hæmoglobin, 70 per cent. Urine normal.

As the patient still complained of severe attacks of pain in the epigastric region, and as her condition was steadily growing worse, she was transferred to the surgical side for operation, the diagnosis being gastric adhesions. When Dr. Lyle opened the abdomen on July 27, 1907, a mass of adhesions was encountered, and the exact relationship of the parts could not be made out. On separating the adhesions, it was found that the stomach was half rotated to the left, and the pylorus was firmly fixed by a short, dense band to the abdominal wall, an inch and a quarter to the left of the umbilicus. There was a corresponding twist in the great omentum. The stomach itself was about half the size of the fist, puckered and scarred. Over the region of the pylorus and lesser curvature the wall was markedly thickened and congested, suggesting a possible old ulcer or a new growth. A section of tissue was removed for examination. The adjacent glands were enlarged. It was decided to shorten

the gastrohepatic ligament to prevent the recurrence of the rotation, and to do a gastro-enterostomy, but during the shortening of the ligament the patient's condition became serious, so the gastro-enterostomy was abandoned and the abdomen closed. She made an uninterrupted recovery, and left the hospital on the fifteenth day, apparently cured of all her symptoms.

She was readmitted to the hospital on August 20, 1908, and stated that since her discharge she had been perfectly well so long as she limited the quantity of her food. The quality did not seem to make any difference. Five weeks ago she began to vomit about half an hour after eating. The ingestion of food began to cause considerable pain, which was referred to the site of the old scar. The pain was sharp and cramp-like in character, and radiated down the left leg to the knee. It was gradually becoming worse, and was very severe at the present time. There was some burning in the throat, and eructations of gas. She had lost 25 pounds in weight in eight months, and had grown quite weak. There were occasional attacks of dizziness; no symptoms of loss of cardiac compensation. The stomach contents showed a slight increase of total acidity, and free hydrochloric acid on the first examination; the second, a loss of acidity and free hydrochloric acid. The abdomen was soft, concave and relaxed, and there was some tenderness in the epigastric region. No mass could be made out. The stomach could not be outlined: six ounces of water distended the organ and gave considerable distress.

A diagnosis was made of possible gastric adhesions, and with the previous history in view it was thought advisable to place the patient under medical treatment for gastric ulcer before proceeding to operation. The patient was thereupon put on Lennhart's regimen, but without benefit.

Operation, September 9, 1908, by Dr. Lyle: On opening the abdominal cavity a small, shrunken and scarred stomach was found; it was covered with adhesions, some of them dense, others thin, extending from the anterior surface of the abdominal wall and from the lesser curvature to the under surface of the liver. The lesser curvature was represented by a dense, scar-like mass, radiating from which were folds of thickened tissue and adhesions. The distance from the pylorus to the cesophageal opening, measured along what remained of the lesser curvature, was less

than one-half inch. The stomach was contracted to about the size of a goose egg, and was almost circular in shape. The stomach wall seemed to be twice the normal thickness.

A no-loop posterior gastrojejunostomy was performed. Considerable difficulty was experienced, due to the smallness of the stomach and the thickness of its walls. The patient made a prompt and rapid recovery, and was out of bed on the thirteenth day. Since leaving the hospital she has remained under careful observation, and is well and strong. She has gained 35 pounds in weight, and has worked steadily. The stomach contents still show a diminished acidity.

At the first operation, Dr. Lyle said, the true condition was not recognized, and it was thought to be a case of ulcer of the stomach with the formation of numerous perigastric adhesions, accompanied by accidental rotation of the stomach. The walls of the stomach at that time were thickened and scarred. The freeing of the adhesions and shortening of the gastrohepatic ligament gave relief for almost a year. At the second operation the uniformly increased thickness of the walls and the marked diminution of the size of the stomach, plus the scarring, showed that we had to deal with something else than a contraction following a simple ulcer. In the causation of this condition we had a combination of two factors, each of which had been given as the cause of the disease: We had a well-marked history of chronic, passive hyperæmia from cardiac insufficiency, the result of repeated attacks of rheumatism, and a strong possibility of multiple peptic ulcers. The chronic condition, plus the irritation set up by the ulcers, would undoubtedly be a sufficient stimulus to start changes in the connective-tissue elements of the stomach, and thus lead to marked general contraction; with the contraction would come of necessity a thickening of the walls until we would find a rigid organ with greatly diminished lumen and thickened walls.

Dr. Lyle said that since the preparation of this report the patient had had four distinct attacks of toxic erythema, due to the taking of meat. These attacks could be controlled by the addition of some dilute hydrochloric acid and pepsin, showing that her stomach digestion was below par for the digestion of meats.

The microscopical examination of the tissue removed showed

a marked increase in young connective-tissue cells in all layers with areas of chronic inflammation, nothing pointing to malignancy.

DR. GEORGE WOOLSEY said that less than two years ago he operated on a man who had been treated on the medical side of the hospital for an ulcer of the stomach, with stenosis. Upon operation the stomach, although not as small as in the case described by Dr. Lyle, was found to be so much diminished in size and its walls so thickened that an ordinary suture operation could not be done, and the Murphy button, which was used instead, did not reach through the stomach wall. The man made a good recovery. A month or two ago Dr. Woolsey said he heard that the man had died of carcinoma, with metastasis in the brain, after a year of good health. The patient was still a young man, 34 at the time of operation. The speaker said he had also seen this condition of thickening and contraction in the rectum and lower sigmoid.

DR. CHARLES N. DOWD asked whether this contracture had been observed in other parts of the alimentary tract? He recalled a case reported by Dr. Welch, of Baltimore, at one of the meetings of the American Medical Association, where a somewhat similar contracture of a part of the intestinal walls had so puckered the intestine as to cause occlusion.

DR. LYLE said that similar thickenings had been reported as occurring in the rectum, colon, and cæcum, where they had probably been regarded as cancerous in nature. Dr. Woolsey's case probably belonged to that class. Cases had also been reported where the duodenum was involved as well as the ileum. In some of these cases they had found a low grade of epithelial tissue.

Dr. Lyle said that he could only find three recorded cases in which the diagnosis had been made during life and later confirmed by autopsy—P. Boulton (1862), Deguy (1896), Osler (1901).

#### MESENTERIC CYST; RESECTION OF ILEUM.

DR. HENRY H. M. LYLE presented a woman, 40 years old, who was admitted to the hospital on August 27, 1910. The patient's family history, as well as her past history, was negative. For a year prior to her admission she had had several



attacks of pain in the lower abdomen, accompanied by vomiting, distention and abdominal tenderness. These attacks would last a few days, and then clear up, only to recur in the course of two or three weeks, and the interval between the attacks was gradually growing shorter. Since her last attack there had been persistent tenderness in the left iliac region. Her chief complaint was recorded as recurrent attacks of pain in the pelvis, with irregular menstruation.

Examination of the abdomen showed some tenderness in both lower quadrants, most marked on the left side. On bimanual examination, a large, cystic mass was found in the left fornix; this appeared to extend up and backwards into the pelvis, and the relation between it and the uterus could not be determined. The mass could also be felt per rectum.

Operation, October 1, 1910: With the patient in the Trendelenburg position, a median incision four inches long was made. On opening the abdomen a mass of congested omentum and adherent coils were found. Upon separating the adhesions a thin-walled cyst about the size of the fist was found between the leaves of the mesentery of the small intestine. The left leaf of the mesentery was detached, and the cyst enucleated up to the gut. At this point the cyst was found to be so adherent to the gut that five inches of the ileum had to be resected. The ends were united by an end-to-end suture, the wound was closed without drainage, and the patient made an uninterrupted recovery.

The specimen was examined by Dr. Francis C. Wood, who reported as follows: A thin-walled cyst filled with gelatinous material. The interior of the cyst was multilocular. The wall of the cyst was composed of connective tissue, without visible lining membrane. Outside was a very loose mesh of fibrin infiltrated with polynuclear leucocytes.

#### CHOLELITHIASIS: STONE IN THE COMMON DUCT.

DR. WALTON MARTIN presented a woman, 72 years old, who had been admitted to St. Luke's Hospital with the diagnosis of carcinoma of the stomach. She complained of vomiting, pain in the epigastrium, and loss of flesh and strength. She was markedly jaundiced. The jaundice, however, from time to time became less pronounced, and the pains were more severe and

paroxysmal than was usual in carcinoma, nor was any mass to be felt. The diagnosis of stone in the common bile duct was therefore made.

Upon operation a medium-sized, freely movable stone was found in the common duct, and was removed. The patient made a good recovery from the operation, although she still had attacks of vomiting.

#### FOREIGN BODIES IN THE PLEURA; CHRONIC EMPYEMA.

DR. MARTIN presented a man, 33 years old, who had had a sinus in the chest for the past four years. At that time he was operated on for empyema, which had followed a pneumonia. For three months the drainage continued; then the sinus closed for a few weeks and again burst open. Since then the sinus had been almost constantly open and discharging pus.

Under ether anæsthesia the sinus was excised and two ribs removed. There was a moderate-sized cavity at the upper and posterior part of the pleura, and the hand passed into the pleural cavity came in contact with a foreign body, which on removal proved to be a drainage tube. Further exploration showed a second tube imbedded in granulations. The two tubes were removed.

After the operation the pleural cavity was irrigated daily, and at the end of two weeks the discharge had almost ceased. The sinus was then filled with Mosetig mixture (oil of sesame and spermaceti, of each 40 Gm.; iodoform, 60 Gm.). Six days later the sinus was closed. The patient had rapidly regained his strength and now weighed over 200 pounds.

#### FOREIGN BODY IN THE PLEURA; CHRONIC EMPYEMA.

DR. MARTIN presented a man, 38 years old, who gave a history of a chronic empyema with a discharging sinus for the past seven years. He had been going from dispensatory to dispensatory to have his wound dressed. From time to time and in certain positions he coughed up a considerable amount of purulent sputum.

Fifteen days ago, under ether anæsthesia, the old sinus was excised, and portions of the second, third, fourth, fifth, sixth and seventh ribs, together with the thickened pleura, were removed. Upon passing the hand into the cavity a small drainage tube was found near the apex of the lung and was removed. The tube was

very foul-smelling, and had evidently been in the pleural cavity for a long time.

A small strip of pulmonary pleura was then excised, and the patient allowed to come out of the ether. Coughing was induced, causing the lung to expand. The wound was then closed and a large drainage tube introduced. For the first few days the stench from his wound was almost unbearable. This had now disappeared and the patient was gaining in weight and strength.

#### ECTOPIC GESTATION; LITHOPEDION.

DR. MARTIN presented a woman, 39 years old, who was admitted to the hospital complaining of pelvic pain. Upon vaginal examination a hard mass could be felt in the posterior cul-de-sac. A part of the mass had a sharp, projecting ridge and felt like a foreign body. X-ray examination showed an indistinct shadow low down in the pelvis. The patient was a widow, whose husband had been dead four and a half years. During the last year of his life she believed herself to be pregnant, and at the fourth month she took measures to terminate the condition by introducing a stylet and injecting kerosene into the uterus. This was followed by a moderate hemorrhage. Since then she had had attacks of pelvic pain from time to time, but had been able to do her housework. About two months ago the pain became more severe.

Under ether anæsthesia a median laparotomy was done. The uterus was normal in size, and on the right side, adherent to it, was a hard mass the size of an orange. It was composed of an adenomatous mass and the skeleton of a fœtus, apparently of the fourth month. The fœtus was curled about the adenomatous mass. The left ovary was cystic.

The mass, together with the cystic ovary and the body of the uterus, was removed. The patient made a good recovery. The projecting edge felt on examination was the humerus of the fœtus, and on re-examining the X-ray picture, its shadow could be indistinctly seen. The fœtus had apparently been in the abdominal cavity for four years.

DR. LILIENTHAL said that in order to illustrate the importance of using the X-rays in tumors of the abdomen, he wished to report the case of a woman who first came under his observation on January 26, 1911. She was apparently suffering from appendicitis, but as she said she was seven months pregnant, and the

fetal heart sounds could be heard, it was decided to postpone operation. When he saw her again, two months later, the uterus had apparently regained its normal size, although she had not been confined, and on each side of the abdomen there was a mass which was supposed to be a fibroid. She had apparently recovered from her attack of appendicitis. The fetal heart sounds could no longer be heard, and the fetal movements had ceased. The woman said she had visited a gynæcologist, who was quite positive that she had not been pregnant.

Dr. Lilienthal had an X-ray taken by Dr. Leopold Jaches, which showed distinctly the fetal head in the right iliac region. The child's ribs and spine could also be made out. Upon operation he found a six or seven months' child lying free in the abdominal cavity, its only attachment being a few small omental adhesions. The membranes had practically rotted away. The placenta was attached to the left ovary; there was no fluid. The entire specimen was removed in one piece and the patient made an excellent recovery.

Dr. Lilienthal said that so far as he knew, this was the first case on record in this country where the diagnosis of intra-abdominal pregnancy was verified by the X-ray.

#### MESENTERIC THROMBOSIS; OPERATION; RECOVERY.

DR. WALTON MARTIN presented for DR. W. SCOTT SCHLEY a man, 42 years old, who was admitted to the First Surgical Division of St. Luke's Hospital on December 23, 1910, having been transferred from the Medical Division and the service of Dr. Theodore C. Janeway.

He had been taken sick twenty-four hours before entrance and several hours after a meal, with a sudden "sharp pain" across the upper abdomen. The pain was continuous from the onset and frequently radiated to the lower abdomen in a stab-like manner. He vomited once, two hours after the beginning of the attack. Vomitus contained no blood. Bowels moved normally morning before attack, but not afterwards, nor had he passed flatus. Urination normal prior to attack. No history of stomach, intestinal, rectal or urinary disturbances before attack. No venereal history could be obtained or history of abdominal trauma. He had had lobar pneumonia four years before, and but for that has worked for many years at his trade and says he has always been a strong healthy man, taking only an occasional glass of beer.

His temperature on admission was  $100\frac{3}{5}$ ; pulse 94 and respiration 24; leucocyte count, 20,000, with a polynuclear percentage of 89.

Examination showed only a moderately distended abdomen with general rigidity. Tenderness to pressure was not marked and seemed somewhat greater over the upper half. Probably some fluid accumulation. The man had the appearance of suffering, and the action of one acutely ill, but as yet in good condition. No definite diagnosis could be made, but abdominal section was clearly indicated.

Operation (Dr. Schley): Ether anæsthesia. On opening the peritoneum in median line below the umbilicus about 200 c.c. of dark red, fairly clear serum escaped. It had no fecal odor. The intestines were moderately distended and showed slight general vascular engorgement. Just below the lower end of the incision, a deep, black-red loop of gut presented. It was found to be part of a good-sized coil in the same condition. The gut was thickened and indurated, and showed a sharp line of demarcation at either end from the healthy intestine. There was a very narrow, quite injected area between the two. The mesentery was a deep chocolate brown with gray black mottling, and was involved for from two to six inches from attachment to gut; the thrombosis affecting the terminal arches. It was much thickened and indurated and almost black on section.

Bleeding from the arteries could be demonstrated, but the veins were thrombosed. The gut was excised four inches on either side of the involved area and the mesentery well beyond demarked lines and to where both vessels bled. The affected gut, nearly two feet in length, was later found to be filled with brownish, bloody fluid and detritus. There was no ulceration of the mucosa apparent to the eye. A rapid examination of the contiguous gut revealed nothing. The ends were brought together in this case by button, reinforced by Cushing stitch and the mesentery by continuous catgut, care being taken in suturings to include no vessel of size. The peritoneum was flushed with hot saline and abdomen closed by layer suture.

The patient stood the operative work well, and on the third day following, gas and some fecal matter began to come away in the rectal saline irrigations. After wound healing appeared primary in every respect, a moderate temperature elevation was followed by an opening in the central part of the scar discharg-

ing some pus and fecal matter. The latter continued fairly profusely for ten days. The patient steadily gained, however, and the fistula contracted.

At his discharge on February 14, there remained a fine probe opening only, and dressings remained unsoiled for two or three days at a time. The button has not come away and radiographs show it still in the lower part of the ileum. The man is steadily gaining and further interference seems unwise at present. It is to be regretted that no cultures were taken from thrombosed veins before the specimen was put in preservative.

It is of interest in connection with this case to summarize briefly some of the collected autopsy records and reports of this condition.

So far the malady in the acute form has proven almost universally fatal, but delayed operations and faulty technic have undoubtedly been partly responsible. Some fifteen autopsy records, at least, show a comparatively small area of involvement with nothing apparent in the recorded findings to contraindicate resection. Some of these would probably have been saved.

In the collection of 214 cases of Mesenteric Embolism and Thrombosis by Jackson, Porter and Quinby, 47 were operated, with 92 per cent. mortality. They consider the cases of the disease may be divided into two groups: acute and chronic; acute, those of sudden onset and by far the larger number and in which death occurs in a few hours or days; the chronic, formed by the small number of cases having an insidious onset, sometimes remitting symptoms, those with no symptoms referable to the abdomen during life and those in whom spontaneous recovery resulted. In either group arterial or venous closure may be the cause. There were 14 cases, equally divided between arterial and venous occlusion, that ran a course of over two months. They were apparently due to a thrombosis with intermittent progression and the establishment of a competent collateral circulation in the meantime. Four cases were found in 1600 post mortems at the Johns Hopkins Hospital in which hemorrhagic infarction of the intestine had occurred without being suspected during life, collateral circulation having been established. Thrombosis of the larger mesenteric vessels and inferior cava has occurred without lethal termination. Brewer has recently reported a case of occlusion of the portal vein. On the other hand, in the acute cases, an inch of involved gut has proved fatal.

Very few cases were diagnosed during life and in the majority the condition was only disclosed at the post-mortem table.

The prompt recognition of a serious intra-abdominal condition in this case and the speedy transfer and operation were certainly very large factors in saving this man's life.

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*Stated Meeting Held April 26, 1911.*

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

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UNILATERAL WIRING OF FRACTURED RADIUS.

DR. WILLIAM C. LUSK presented a young man in the service of Dr. Keyes at St. Vincent's Hospital, who had a fracture of both bones of the forearm in their lower thirds. The ulna united, but union between the fragments of the radius was prevented by interposition of muscle.

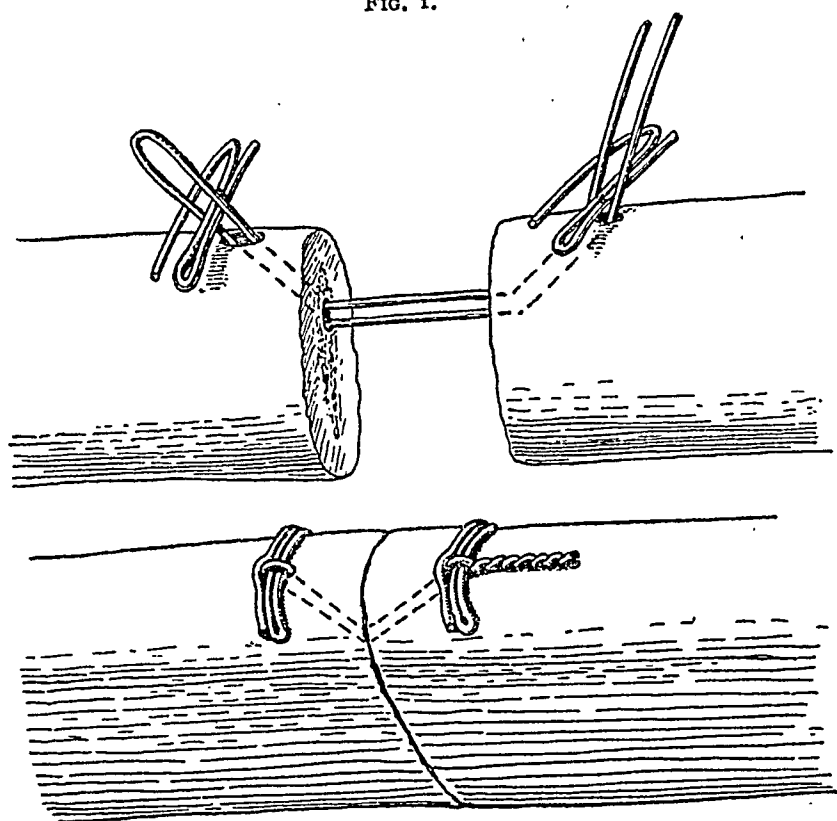
Operation, August 31, 1910, by Dr. Lusk: The preference for fixation of the fragments of the radius with wire was determined by the fact that an incision on the outer side of the forearm to reach the radius at the seat of the fracture must necessarily be of the gridiron type, access to the bone being gained here between the extensor ossis metacarpi pollicis and the extensor brevis pollicis, which pass obliquely across the radius and do not permit of wide retraction. About one-quarter inch was removed from the lower fragment, and a No. 22 silver wire inserted, as shown in the diagrams. It could be seen that when the cross-bar, made of a trifoldd piece of wire, had been caught within the looped end of the main wire passed through both borings, and the free ends of the main wire were then pulled upon so as to take up the slack, the fragments necessarily came together. The fixation cross wires were each folded three times, the double fold being passed beneath the loop of the main wire to anchor it, while the third fold passed outside the loop to clinch its hold. With its two extremities thus firmly fixed, the loop of wire held like a bolt.

The line of fracture was oblique from before backward, and in the result there was some anteroposterior overlapping, but the lateral margins were in perfect line, and the functional result left nothing to be desired.

In drilling bone, Dr. Lusk said, he always used a carpenter's

drill for drilling steel, fitted to a brace. In applying this form of fixation to the larger bones he would recommend the use of two of these wires placed a little apart.

FIG. 1.



Unilateral bone wiring. With its two extremities firmly fixed, the loop of wire holds like a bolt

#### SUPRACONDYLOID FRACTURE OF THE FEMUR.

DR. LUSK presented a boy, six years old, who had been in the service of Dr. Joseph D. Bryant at St. Vincent's Hospital. The original deformity consisted in an over-riding of the fragments, the upper projecting in front and internally.

Operation, February 22, 1911, three weeks after receipt of the injury: Through an internal incision from one-half to five-eighths of an inch of bone was removed from the upper fragment, which then had to be notched externally to fit a prong of bone projecting upward from the outer side of the lower fragment. Fixation by Lane splint. No other form of fixation could have held the fragments so easily or so well. The fracture was very close to the condyles, and the lower fragment could not be turned out through the wound. To have wired the fragments, an external incision would have been required as well, which must necessarily



have entered the synovial pouch of the knee-joint. In the lower fragment but just enough bone surface could be bared internally above the joint structures for the insertion of one screw, so that the only variety of Lane splint that could be used here was one with two screw holes above and one below.

Primary union followed the operation. The inner surfaces of the two fragments were held in the same plane by the Lane splint, but externally the prong of bone projecting upward from the lower fragment lay a little away from the direct line of the upper fragment, causing a slight lateral projection in the repair line. There was seven-eighths of an inch shortening, with good function.

#### COMPOUND COMPLICATED FRACTURE OF THE LEG TREATED WITH CHINOSOL.

Dr. Lusk presented a man who was admitted to St. Vincent's Hospital, in the service of Dr. Keyes, on August 23, 1910. He was suffering from a compound fracture of the lower third of the right leg, and a deeply lacerated wound at the inner side of the right ankle, opening into the ankle-joint, the whole inner surface of the astragalus having been avulsed. There were no lacerations of tendons, and the arteries and nerves were intact.

The ankle-joint and the compound fracture of the leg were drained at once, and an irrigating tube was introduced into the ankle-joint and another just in front of the seat of the fracture of the tibia, and each of these was connected with a fountain syringe. The wounds were flushed with eight ounces of chinosol solution, 1:500, through each tube every thirty minutes for the first twenty-four hours, and then the interval was increased to one hour. On the third day the strength of the solution was diminished to 1:1000, and the interval increased to two hours. On the fourth day the irrigations were discontinued. The wounds were perfectly drained, and were subsequently cared for by simply changing the dressings, the sinuses never having been syringed again.

Dr. Lusk said the remarkable feature of this case was that on the fourteenth day union between the fragments of the tibia was so solid that not the slightest lateral motion could be elicited. There was a little spring at the seat of the fracture, and by traction on the foot the lower fragment of the tibia could be seen to descend about one-quarter of an inch. There was a shell of necrotic bone on the inner surface of the end of the upper fragment.

On December 31, 1910, the patient began walking about his room, using a cane only. In March, 1911, he was operated upon for sequestra. He has one and three-quarters inches shortening. With the use of an appropriate shoe he can now walk as far as half a mile at a time.

Dr. Lusk said that in the treatment of wounds with chinosol irrigations, pyocyaneus would frequently be found in the dressings, in the event of which occurring the addition of carbolic acid in a strength of 1:500 had been found effectual to prevent the growth of this bacterium.

#### DRAINAGE OF A SEPTIC KNEE-JOINT.

DR. LUSK presented a man, 49 years old, who was admitted in September, 1903, to Bellevue Hospital, in the service of Dr. Bryant, suffering from a pure streptococcus infection of the knee-joint. All the posterior recesses of the joint, *i.e.*, those behind both condyles of the femur and those behind both tuberosities of the tibia, were drained dependently. The drainage was effectual from the start, and the patient recovered with ability to flex his leg to an angle of about 80 degrees. Particular attention was called to a large synovial pouch situated between the external tuberosity of the tibia and the popliteus muscle, involvement of which had been found to be the cause for tenderness and swelling in this location in knee-joint suppuration. The skin incision for reaching this pouch was made along the front of the biceps tendon, curving a little backward, and the biceps tendon was dissected free anteriorly close to its insertion into the head of the fibula, until the bony notch between the styloid process of the fibula and the tuberosity of the tibia could be felt. From this notch, in a line upward and forward toward the tuberosity of the external condyle, which corresponded to the interval between the long external lateral ligament and the popliteus tendon, the incision was made through the capsule to enter this pouch. The site of this incision could be made prominent by passing a curved dressing forceps or a blunt scissors, curved on the flat, through an incision into the joint along the outer side of the patella backward and a little downward beneath the external lateral ligament, relaxed by flexion. The popliteus tendon was attached to the semilunar cartilage where it crossed the latter, so that the opening, which must be below the semilunar cartilage, could not be a very large one. If now a dressing forceps were pushed straight inward into this pouch, it met the resistance of a dense unyielding

attachment to the tibia which underlay the situation of the popliteal artery; but if, instead, the dressing forceps were passed inward and downward, in a direction corresponding to that of the groove where the head of the fibula met the tibia posteriorly, then the instrument could be pushed through the soft parts, and, breaking through the fascia covering the popliteus muscle, would find its way to beneath the skin at a situation a little behind the semitendinosus tendon. The bottom of the pouch behind the external condyle was reached through an anterior incision lateral to the patella, with a scissors curved on the flat, passed straight backward, hugging the tuberosity of the external condyle, the knee being flexed. To reach the bottom of the pouch behind the internal condyle the scissors must be passed backward and upward. To open the pouches behind the condyles without preliminary introduction of an instrument inside through anterior incisions, it was easiest, after exposing the capsule, to cut it in a direction from behind forward directly on to the condyle. The external popliteal nerve on the outer side must be kept in mind.

A narrow pouch, about one inch in depth, between the internal tuberosity of the tibia and the semimembranosus tendon was opened in this case by cutting loose the attachment of the internal semilunar cartilage to the tibia at this situation. The necessity for draining this pouch generally would seem doubtful. The subquadricepital bursa was drained, and tubes were passed beneath the lateral ligaments. The pouches behind the condyles and that behind the internal tuberosity were fitted with irrigating tubes with an eye cut near the end of each, which came out through the dressings and were connected together with V-shaped glass tubes until they all communicated with one reservoir, through which intermittent flushings were carried out. The knee was maintained in a position of a few degrees of flexion. On the eighth day silkworm gut strands were substituted for the tubes.

At the present time, Dr. Lusk said, he drained the subquadricepital bursa at its dependent portion, just above the external condyle, which lay immediately in front of the aponeurosis of the vastus externus near its attachment to the femur; he used an abundance of silkworm gut strands for drainage material that must be carried beneath the lateral ligaments, and he preferred this material to tubes, which were very painful in this situation and provocative of ulceration. In his last case of knee-joint

drainage, which was one in which the posterior pouches were not opened, he made transverse incisions on either side of the tip of the patella instead of longitudinal ones along this bone, which were equally effective in controlling the suppuration and did not leave ugly scars to fix the patella on either side. He did not recommend draining the posterior pouches in suppurative arthritis of the knee unless their involvement was suspected or evident. The liability of involvement of the pouch between the semimembranosus and the inner head of the gastrocnemius in knee-joint suppuration was likewise to be borne in mind.

#### OPERATIVE TREATMENT OF FRACTURE OF THE FEMUR.

DR. JOHN B. WALKER presented a man, 43 years old, who was struck on the right thigh by a large brick. An hour later a side splint was applied, and he was brought to the hospital in an ambulance. On the following day the splint was removed, and examination showed an oblique, spiral fracture through the middle third of the femur. There was 4.5 cm. shortening. A long side splint, with Buck's extension, was applied. At least fifteen pounds weight was used, which was increased to twenty within twelve hours.

Two days later a radiograph was taken, which showed accurately the obliqueness of the fracture, the over-riding and the angulation, together with several comminuted fragments. Hoping to reduce this over-riding by traction, the weight was increased to twenty-five pounds, which was all the patient could bear. Three days later a second radiograph was taken, which showed that only slight improvement had occurred.

Ten days after the accident, the patient accepted the necessity of an operation. A twelve-inch incision was made over the outer aspect of the right thigh, which gave a good exposure of the fragments. A small amount of callus was found, but practically no union existed. Two large, sharp-pointed fragments which were unattached and lay between the tissues were removed, and the ends of the bones were carefully freshened. Forcible traction was then exerted to reduce the over-riding of 3.5 cm., but this proved successful only when the muscles were detached for a considerable distance along the shaft of both the upper and lower fragments. The fragments were brought into alignment and finally secured by the application of a large sized Lane plate, about six inches long. Two screws were placed in the upper fragment, and two in the lower. Although the Lane plate held

the fragments in apposition and alignment, yet on account of the marked obliqueness of the fracture and because the plate was placed on the anterior surface of the fractured bone, it did not prevent backward bowing. A strand of silver wire was now placed around the lower end of the upper fragment and the upper end of the lower, and this produced a perfect result.

There was considerable bleeding during the operation, but this had largely ceased when the operation was completed, so that no drain was used. The muscles were not sutured, and the overlying fascia was united by fine chromic gut and the skin by silk. A plaster bandage was applied from the pelvis to the toes. Primary union followed, and on the fourteenth day the plaster was removed up to the ankle. Measurements then taken showed that the over-riding had been entirely overcome, and that both legs were of the same length. The radiograph showed perfect alignment.

On the twenty-eighth day the plaster was removed up to the knee, and the patient sat up in bed. Eight days later he began to go about on crutches, and on the fifty-sixth day the plaster was entirely removed and he began to walk with a cane. A week later he was able to dispense with all artificial support. There was considerable motion at the knee, which was steadily improving. Three months had elapsed since the operation, and there had been no complications on account of the presence of the plate. Without the operation, the shortening and angulation would have persisted, and he would have been permanently crippled.

Dr. Walker also presented a woman, 41 years old, who sustained a fracture of the right femur through its middle third. One hour after the fracture occurred it was reduced, and a plaster bandage was applied from the hip to and including the toes. The patient remained in bed; at the end of eight weeks a radiograph showed an oblique fracture, with some angulation, and over-riding of about 2.5 cm.; some callus but only slight union had occurred. Two weeks later (ten weeks after the accident), the patient came under Dr. Walker's care for operation. A ten-inch incision was made over the outer aspect of the thigh. The callus which had formed was removed, and the fragments, which were separated from each other, could not be brought into apposition or alignment even with the most forcible traction until the muscles had been freely detached from the shaft of the femur. It was necessary to use Lane's largest and most powerful forceps

to bring the fragments into accurate position. A large six-inch Lane steel plate was then applied, being secured by two screws to the upper and two screws to the lower fragment. No drain was used and the muscles were not sutured. The overlying fascia was united with fine chromic gut and the skin with silk. A plaster bandage was applied from the pelvis to and including the toes.

Primary union followed, and four weeks later a radiograph was taken which showed the plate and the fragments in perfect position. On the following day the plaster was removed, and gentle passive motion begun. Three weeks later another radiograph was taken, which showed that the plate had been loosened from its attachment to the upper fragment, and that some angulation had occurred. Dr. Walker said he believed this was due to the too early removal of the supporting case, and he desired to emphasize the necessity of allowing the case to remain for eight weeks, instead of four, as in this instance. This course had been followed in fourteen other cases following operation for fracture of the femur, without complication.

#### PYLORIC ADHESIONS FREED BY OPERATION.

DR. EDWARD M. FOOTE related the history of a woman, 35 years old, who was referred to him by Dr. Wm. Van V. Hayes, with a long-standing history of epigastric pain and symptoms of motor inability of the stomach. Upon operation, it was found that the pylorus was bound down to the liver and the posterior abdominal wall by close adhesions. These were divided, and the pylorus freed. Since the operation, which was done on October 28, 1910, the patient's symptoms of gastric trouble had entirely disappeared.

DR. LEWIS GREGORY COLE exhibited a series of X-ray plates of the case presented by Dr. Foote. These were taken before and after the operation, and illustrated, first, the deformity produced by the pyloric adhesions, and then the return of the normal gastric peristalsis of the stomach after the adhesions had been divided.

DR. ROBERT T. MORRIS presented a case similar to the one related by Dr. Foote. The patient was a man, 45 years old, without any history bearing on the present condition. He began to lose weight and had morning vomiting and hyperacidity. With bismuth solution in the stomach the fluoroscope showed interference with motility at the pylorus, due to adhesions at that

point. Upon operation they were divided, and Cargile membrane introduced to prevent their recurrence. Seven days later while all was going well the abdominal wound suddenly opened for a distance of four inches through the skin and superficial fascia. There was no evidence of sepsis.

The speaker said that he had a probable explanation for these cases of failure of union of the abdominal wound after stomach operations. He called attention to the areas of sensory disturbances, described by Head, and stated that we undoubtedly had neurotrophic disturbance accompanying sensory disturbance in the gastric zone of Head, the base of which lay in the midline between the navel and the ensiform cartilage. This was a probable explanation for the disproportionate number of cases of failure of union of superficial tissues, without sepsis, after gastric operations.

In this particular case the very slow repair of the wound while the patient was daily gaining in weight rapidly gave further evidence of neurotrophic disturbance corresponding to the area of sensory disturbance of the gastric zone of Head.

Also the pyloric adhesions which had developed without history of acute inflammation, Dr. Morris had described them frequently as cases of "cobwebs in the attic of the abdomen." They were very common, but seldom attracted attention unless they interfered with motility of the stomach or caused some reflex disturbance. These "cobwebs" are probably of toxic origin due to bacteria or toxins excreted by the liver and causing desquamation of endothelium in the vicinity. Plastic exudates following this toxic desquamation of endothelium form the "cobwebs in the attic."

Now that interference with motility of the stomach is being observed by diagnosticians with the fluoroscope, the diagnosis of a condition to which the speaker had been trying to attract attention for some years would be made frequently, and we would have a definite explanation for a certain proportion of our intractable dyspepsias.

#### CASES OF HERNIA WITH UNUSUAL FEATURES.

DR. A. V. MOSCHCOWITZ showed six cases, which he said all came under his observation during the past six weeks.

CASE I.—*Strangulated hernia in an infant five months old.* The history obtained in this case was that the baby cried a good

deal, and upon examination the mother noticed a swelling in the left groin.

When the child was brought to Mt. Sinai Hospital it was apparently perfectly well with the exception of the swelling in the groin, which was judged to be due to a strangulated hernia. At the operation the speaker found the sac of an inguinal hernia containing a tube and ovary. These were not strangulated by the neck of the sac, but were completely twisted and necrotic. The child made an uneventful recovery.

DR. WILLIAM A. DOWNES said he recently saw a very similar case in the service of Dr. Murray at the New York Hospital. The patient was a child, three months old, with a strangulated right inguinal hernia without any disturbance of the bowels. Upon operation, the hernial sac was found to contain a tube and ovary which were strangulated by torsion, two complete turns having taken place. The child made a perfectly good recovery. Dr. Downes exhibited the specimen which was removed.

DR. MOSHCOWITZ said he had looked up the literature of so-called strangulated ovary and tube, and including the case just recorded by Dr. Downes, there were nineteen in all. In all of these there was never a strangulation of the hernia, but practically always a twist.

CASE II.—*Strangulated inguinosuperficial hernia: undescended testis.* The patient was a man, 63 years old, who was admitted to the Har Moriah Hospital with the diagnosis of strangulated hernia. He gave a history of having had a hernia all his life, and he also knew that he had only one testicle. The hernia, of the size of an adult head, lay upon the abdomen and did not descend into the scrotum.

The patient was operated upon, and in the lower part of the hernial sac, in a large cavity completely shut off by itself, was a small, atrophied testis, located about opposite McBurney's point. Above this was a huge hernia, containing a large mass of omentum and small intestine. The patient made an uninterrupted recovery.

This was the first time, Dr. Moschcowitz said, that he had ever seen a complete tunica vaginalis in a case of undescended testis.

CASE III.—*Double inguinal hernia associated with tuberculous peritonitis.* This patient was a woman with a double inguinal hernia; both hernial sacs were studded with innumerable miliary tubercles.



CASE IV.—*Artificial hernia.* The patient was a young man who came to this country eight or nine years ago from Russia. After living in this country for a time he became homesick and went back to Russia, where he was notified to present himself for examination for service in the army. In order to avoid such service, his father took him to a certain address where he was laid flat on the floor with his hands under his head. Then a man sat on his head to keep him quiet, while a second man—not a physician—invaginated one of his fingers in the region of the external abdominal ring. This caused such excruciating pain that the young man fainted. He was then taken home and instructed to use snuff to make him sneeze and to drink freely of an infusion of yeast to make him vomit. He sneezed and vomited during the greater part of the night, and by the following morning a hernia had developed. When he presented himself for examination to the army surgeons they suspected that the hernia was artificial, and he was accepted. After three months' service he deserted and came to this country, and was operated on for his hernia in Brooklyn. This was followed by a recurrence. He now had a direct form of hernia.

CASE V.—*Sliding hernia of descending colon.* The patient was a young man who had a hernia, probably since birth—surely, since he was two years old. When Dr. Moschcowitz operated on him, two months ago, he found a huge sliding hernia, without a sac. In the course of this operation the intestine was accidentally injured, necessitating suture.

This operation was followed by a rapid recurrence, and upon reopening the abdomen it was found that not the sigmoid flexure, but the descending colon entered the hernia. This organ was pulled back into the abdomen, and fastened by sutures to the posterior parietes. It will be of interest to see whether or not a recurrence will take place after this operation.

CASE VI.—*Strangulated prevascular femoral hernia.* Dr. Moschcowitz showed a photograph of a case of strangulated prevascular femoral hernia. The operation in this case was done very recently, and the patient was still confined to bed.

#### HYPERTROPHIC ARTHRITIS OF THE HIP TREATED BY ALBEE'S OPERATION (ARTHRODESIS).

DR. WILLIAM DARRACH presented a woman, aged 29 years, who ten years ago jumped from a runaway carriage, wrenching her right hip. For a few days after this she was lame and

sore. Four months later, after exposure, she was in bed for sixteen weeks with what was said to be sciatica. When she was able to leave the bed her right hip was partially ankylosed in marked adduction, with some flexion, so that when she stood upright there was a difference of three and a half inches apparent shortening. During the next four months this gradually decreased until she was able to walk with a moderate limp. Eighteen months later, when she entered the Presbyterian Hospital, there was an inch of real shortening, with flexion to about 145 degrees. She was put up in Buck's extension for six weeks and then transferred to the Hospital for Ruptured and Crippled, where she remained for five weeks. At the end of that time she could walk with much greater ease, and three months later she returned to work. Four years later she tried osteopathic treatment for six months; during the first two months this increased her motion somewhat, but at the end of the time the movements were no freer than at the beginning, and the pain was a good deal worse.

She remained at work from October, 1903, until one year ago. During this time there was almost constant, dull, aching pain in the right hip, which was made worse by walking. In sitting at her work she had to keep her right leg under her chair in order to sit upright.

When the patient came to the Roosevelt Hospital, on March 14, 1910, there was still one inch actual shortening, flexion was limited to 145 degrees, abduction was restricted, as well as rotation. She had to use a cane most of the time. The X-ray showed a marked hypertrophic growth of the acetabular margin. The operation described by Albee was done on March 17, the only modification being the method of approach, the antero-external incision of Flint being used. The upper third of the head of the bone was removed, and the cartilage scraped from as much more of the articular surface as could be reached. The upper portion of the acetabulum was removed, making a flat surface for the cut surface of the femur to rest on. In order to overcome the adduction, the adductor longus had to be cut near its origin. The wound was closed without drainage, and a plaster spica applied from the costal margin to the ankle. This was allowed to remain for five weeks, when the stitches were removed and a new plaster applied to just above the knee. This was allowed to remain for nine weeks longer, and she was then permitted to go about on crutches, gradually using the leg more and more.

Since the operation, the patient had been absolutely free from pain in the hip, but for about six months there was pain over the cut adductor, with paræsthetic sensations over the region below the scar. She is now able to walk with a slight limp, there being firm ankylosis with marked compensatory movement in the lower lumbar and lumbosacral joints.

A careful pathological examination showed no evidence of any tuberculosis in the sections of bone removed.

#### TRAUMATIC ASPHYXIA.

DR. PARKER SYMS presented a man, 23 years old, who was admitted to the Lebanon Hospital on March 21, 1911. His previous history was negative, excepting that he had had one former attack similar to this one.

One hour before admission the patient suddenly became unconscious and fell, while operating a moving picture machine. The unconsciousness lasted for only a few moments. When the ambulance arrived he was conscious, but confused, and answered questions slowly. After his fall, the onlookers stated that his face became a dark blue color.

Upon his arrival at the hospital there was very deep cyanosis extending as far down as the level of the thyroid cartilage. There was a scalp wound and hæmatoma over the right parietal region, and an incised wound in the forehead, evidently due to the fall. There was bleeding from both ears, a large, subconjunctival hemorrhage in both eyes, and bleeding from both nostrils.

The hæmatoma was incised and the skull exposed without finding any external evidence of fracture, and there were no focal signs indicating an intracranial injury. While the hemorrhages noted above suggested a fracture of the base of the skull, the patient's rapid improvement dispelled that idea.

This man was reported to have had a similar attack five years before, which came on spontaneously. The speaker said he regarded the case as one of traumatic asphyxia due to epilepsy. Such cases had been reported. Usually, traumatic asphyxia had resulted from a severe compression of the thorax or abdomen in some crushing accident.

In the case presented, the man's cyanosis gradually disappeared, the subconjunctival hemorrhages were absorbed, and he left the hospital within a week, apparently perfectly well.

SUSPECTED TUMOR OF THE BRAIN: DECOMPRESSION  
TREPHINING.

DR. SYMS presented a boy, four years old, who was admitted to the Lebanon Hospital on February 15, 1911, with the diagnosis of intracranial pressure. His chief complaint was progressing blindness. Until three weeks before admission he had been perfectly well. He then began to complain of headache, intermittent in character, which was his only symptom until one week before admission, when it was noticed for the first time that the child was unable to see. There were no muscular twitchings, no convulsions, no vomiting, no weakness, no disturbance of gait, no chills nor fever. Dr. William M. Leszynsky examined the patient and made a diagnosis of intracranial pressure, probably due to a tumor in a silent area of the brain.

In the left eye vision was greatly diminished, and in the right eye there was complete loss of sight. There was much swelling and oedema of both papillæ. In other words, there was increasing choked disk on both sides, that of the right eye being more marked than that of the left.

On February 20, 1911, Dr. Syms did a decompression operation by removing a section of bone about two inches in diameter from under the temporal fascia. The dura was pulsating and apparently normal. It was not opened, for experience had shown that sufficient expansion may take place without incising the dura.

The boy made an uneventful recovery. Improvement began very promptly, and long before he left the hospital he had practically normal vision in both eyes, and no symptoms which pointed to any permanent disorder.

DR. WILLIAM M. LESZYNKY said that the diagnosis in this case, prior to operation, rested between an internal hydrocephalus and brain tumor. The choked disks and blindness were simply indicative of intracranial pressure and there were no focal symptoms: no headache, no vomiting, no vertigo. He thereupon advised a decompression operation, without opening the dura. This was done, as had been described by Dr. Syms, and the patient made a complete recovery so far as the vision was concerned.

The important point illustrated by this case was that where a decompression operation is indicated, it should be done at once, before more advanced and permanent disturbance of vision has taken place.

## TORSION OF THE OMENTUM: SUPPURATIVE PANCREATITIS.

DR. SYMS showed the specimen in this case on account of the comparative rarity of the lesion. The patient was a man, 47 years old, who was admitted to the Lebanon Hospital on January 21, 1911. Twelve years ago he had been operated on for right inguinal hernia; this had recurred five years ago. Otherwise, his past history was negative.

Four days before admission, the patient's hernia became irreducible for a time, but it was finally reduced the day prior to his admission. He complained of severe pain in the right iliac region; this was lancinating in character and continued up to the time he came into the hospital. The patient's bowels had not moved for four days. He had no chills, no fever, no vomiting.

Examination showed a well-nourished, well-developed man. His abdomen was very much distended and was markedly tender, especially over the right side. Examination of his hernial region showed nothing excepting that there was no hernial protrusion. His temperature on admission was 100; pulse, 100; respirations, 28. A blood examination showed increased leucocytosis, with 90 per cent. of polymorphonuclears.

Operation: An incision was made through the right rectus muscle, exposing a large mass which proved to be a strangulated portion of omentum, due to torsion. The omentum was attached at its lower right corner; it had rotated high up, so that a large portion of the omentum was strangulated, although not quite gangrenous. It was filled with blood clots and dilated thrombotic veins. The omentum was twisted four times; that is, four complete turns were necessary before it was unwound. It was ligated above the point of torsion, and the strangulated portion was removed. Nothing else was discovered at the time of the operation, excepting a much distended bowel, which seemed to be due to an adhesion and kinking of the intestine.

On the morning following the operation, the patient presented increased signs of intestinal obstruction, and a colostomy was done near the region of the cæcum. This gave only partial relief, and on account of the increased distention and fecal vomiting, another enterostomy was performed, an opening being made in the loop of the small intestine. This relieved the signs of intestinal obstruction, but the toxæmia persisted. The cause of this could not be made out, in spite of various examinations. There were no evidences of a pancreatitis, although they were



pital he had been assaulted, being struck over the left parietal bone with a bottle. He was brought to the hospital in a state of deep coma, with stertorous breathing and evidences of pulmonary œdema, presenting the picture of a severe fracture of the base of the skull.

At autopsy the brain was found to be congested. There was a small clot in the fissure of Rolando, and it was found that the posterior clinoid process had been fractured completely from its base. There was no other fracture of the skull. Dr. Syms remarked upon the rarity of such an injury existing as an isolated lesion.

#### GANGRENOUS APPENDICITIS WITH TWO LARGE FECOLITHS IN THE APPENDIX.

DR. SYMS showed this specimen, which was removed from a young boy who was brought into the hospital within twenty-four hours of the beginning of a very severe attack of appendicitis. He was operated on without delay, the operation being done with the aid of the aspirating or suction apparatus which was described by Dr. Alexander B. Johnson at a meeting of this society on January 25, 1911. The appendix was found to be gangrenous and perforated near its base. The abdomen was filled with seropurulent fluid, and there had been an escape of some fæces. At the completion of the operation, which occupied about five minutes, the abdomen was drained, and the patient made a satisfactory recovery.

Two large calculi were found in the appendix, and it was interesting to note that these stones were more opaque to the X-rays than were the typical gall-stones. Possibly they might have been demonstrated *in situ*.

#### THE ASPIRATING CUP AS A TRACTOR.

DR. SYMS demonstrated this apparatus. He stated that a week ago he had occasion to enucleate a cyst of the thyroid, and he was able to do this through a small incision by using an aspirating cup as a tractor. After freeing the anterior and lateral portion of the cyst wall, the cup was placed over it and the cyst was at once sucked up into the cup out of the wound, and he then had only to deal with the base of the cyst, which was easily separated from the isthmus of the thyroid at its point of origin.

Dr. Syms thought that this method of utilizing this device, with proper modifications, might prove useful in many instances. Certainly all cysts could be remarkably well handled

thereby. It would be an excellent aid in grasping the gall-bladder if one wished to do a cholecystectomy without opening the gall-bladder, and it doubtless would be of assistance in grasping tumors, such as thyroid lobes, prostatic lobes, etc.

Dr. Syms said that since demonstrating this method his attention had been called to the fact that Fedor Krause had recommended the employment of the same device in grasping and delivering brain tumors.

#### GIANT-CELLED SARCOMA OF THE TIBIA: ENUCLEATION.

DR. L. W. HOTCHKISS presented a man, 23 years old, a truck driver by occupation, who four years ago first noticed a hard lump on the shin, above the inner malleolus of the tibia. Its development was slow and gradual; at first, pain was present only on walking, but lately this had become more pronounced and had caused considerable suffering after the patient was on his feet for any length of time. The pain was generally of a stabbing character, located in front of the ankle and radiating up the tibia and the calf of the leg. Recently it had practically incapacitated him from active, continuous work.

Examination showed an oval tumor on the inner surface of the tibia, extending from just above the malleolus upward for a distance of about four inches. It was about two inches thick at its widest portion, expanding the bone in all directions. (See X-ray pictures.) Its outline showed a conical-shaped tumor, with its base just above the articular cartilage of the tibia, and its truncated tip pointing about 4 inches above. It was bony, hard to the touch, tender, smooth, with a regular outline, and gave rise to no fluctuation or crackling on palpation. Extension, abduction and adduction of the foot were limited, and there was pain on passive motion. The patient walked with a limp, and the foot was held slightly inverted. At the level of the tumor the circumference of the right leg was 3 cm. greater than that of the left. The patient's temperature was 99.1; pulse, 96; respirations, 24. Urine, negative.

Operation, December 17, 1910: A long incision was made over the mass and deepened to the bone. The shell of bone covering the tumor was thin and easily removed, the posterior portion of the shaft being left in continuity. The tumor was enucleated with the finger, save for a small section of the growth which extended down into the base of the malleolus; this was broken off and removed separately. The large defect in the bone



FIG. 3.



Sarcoma of lower end of tibia, viewed transversely

FIG. 4.



Appearance of tibia after enucleation of diseased portion; anteroposterior view.

FIG. 5.



Appearance of tibia after enucleation of distal end of tibia, viewed transversely.

FIG. 6.



Sarcoma of lower end of tibia, anteroposterior view.

was almost entirely closed by deeply infolding the edges of the incised skin over the edges of the remaining bony shell, and holding them in place by a series of Lembert sutures. To aid in the retention of the skin flaps, a cigarette drain covered with rubber was placed in the long axis of the wound, and held in contact with the skin surface of the infolded flaps by the sutures. Primary union resulted.

At the present time, four months after the operation, the patient was going about without a cane and was able to bear some weight on the foot. The wound had remained healed, and there was no evidence of a local recurrence. The X-ray pictures showed the patient's condition before and after operation (Figs. 3, 4, 5, and 6.)

Upon gross inspection the tumor removed in this case was smooth, non-encapsulated, having the consistency of rubber, and mottled red, gray and white in color. Pathologically it was pronounced a giant-celled sarcoma. There were numerous cysts about 1 mm. in diameter scattered through the specimen and numerous giant-cells. The case was shown as an example of the propriety of excision instead of amputation in a giant-celled sarcoma of the extremity.

#### SUPPURATIVE CHOLECYSTITIS (PARATYPHOID): CHOLECYSTECTOMY: COLOSTOMY.

DR. L. W. HOTCHKISS presented a man, 50 years old, who was admitted to Bellevue Hospital on October 31, 1910. His family history was unimportant. The patient had been moderately alcoholic. He had smallpox seven years ago and gave a history of rheumatism. Denied typhoid or other fevers.

Three weeks prior to admission the patient began to suffer from diarrhœa following a chill. The diarrhœa became worse, until he was having about twenty movements a day, the movements being largely composed of slimy matter, and on the day before his admission blood was noticed in the stools for the first time. He gave a history of having had a somewhat similar attack three years ago.

A proctoscopic examination revealed extensive ulceration of the rectum and sigmoid, with small ulcers of the mucosa. No amœba coli were ever demonstrated in the discharges. The patient improved temporarily under treatment, but on November 17 he had an elevation of temperature, with a chill and pain over the liver. His symptoms continuing, he was transferred to the surgical division with a tentative diagnosis of liver abscess.

November 21, 1910, Dr. Hotchkiss opened the abdomen above the umbilicus through the right rectus. The gall-bladder, much distended and inflamed, at once presented and aspiration through its thickened wall revealed pus. A cholecystectomy was thereupon done in the usual manner, the cystic duct being ligated with cat-gut and a cigarette drain introduced to the stump. The abdominal wound was then closed. On account of the history of colitis, with ulcerations, it was thought best to do a colostomy for the purpose of washing out the gut. This operation was done through the usual gridiron incision, and a tube introduced into the cæcum.

Cultures which were made from the contents of the gall-bladder were reported by the pathologist, Dr. Chas. Norris, to be pure cultures of the paratyphoid organism. The lesion of the gall-bladder was a chronic, suppurative cholecystitis, with marked hemorrhagic infiltration of the walls of the gall-bladder, and almost complete destruction of the mucosa. A week later paratyphoid bacilli were demonstrated in the stools, apparently proving the connection between the intestinal and the gall-bladder lesions.

The abdominal wounds healed promptly, but the operative fistula was still maintained in the cæcum, and irrigations with argyrol solution were continued, although no paratyphoid organisms had been found in the stools since December 21, 1910. Any considerable interruption of the irrigations was liable to be followed by bloody stools.

Dr. Hotchkiss said this case was shown as an example of a paratyphoid carrier in which the gall-bladder as well as intestine were the foci of infection.

#### FRACTURE OF THE INTERNAL SEMILUNAR CARTILAGE.

DR. HOTCHKISS presented a man, 35 years old, who was admitted to Bellevue Hospital on February 18, 1911. He complained of pain and swelling of the left knee, with inability to bear his weight on the left leg. The history he gave was that on the day previous to his admission he had jumped from a moving freight train, landing with his left foot on a sleeper, the toes turning inward and at the same time twisting the knee sharply. With the assistance of several men he reached a stable, where he spent the night, and on the following morning he was brought to the city and admitted to the hospital.

The only point of interest in connection with his past history was that about eight years ago, while playing base-ball, he attempted to slide to base, and in doing so his left knee received a severe twist, which disabled him to such an extent that he was taken to a hospital in an ambulance, and was confined to bed two weeks with the leg strapped and bandaged. Since that time he thought the knee had always been more or less weak.

Upon the patient's admission to Bellevue, his left knee was found to be swollen and tender. Any motion gave rise to pain, and the tenderness was especially marked at the inner aspect of the knee along the head of the tibia and the inner border of the patella. An X-ray picture was taken, which gave negative results. A pressure dressing was applied, under which the swelling disappeared after a few days, but in view of the persistence of tenderness and the patient's previous history, a tentative diagnosis of rupture of the internal semilunar cartilage was made.

Operation, March 4, 1911: An incision was made along the inner edge of the patella, from the internal condyle of the femur to a point well over the head of the tibia. A curved incision was then continued backward along the tibial head, as proposed by Morrison, and the knee-joint was opened. A gush of blood-stained synovial fluid marked the opening of the joint, and a free exposure of the cartilage was obtained. There was evidence of an old fracture through the internal semilunar cartilage, and a small fragment of the articular cartilage of the internal condyle of the femur was gouged out and lay free in the cavity of the joint. The cavity was filled with a blood clot, showing that the detachment of the piece of articular cartilage was of recent date.

As much as possible of the internal semilunar cartilage was removed; the capsule of the joint was closed with catgut, and the skin with silk. A plaster case was applied and kept on for about three weeks. There was primary union, and the patient's convalescence was uneventful. After removal of the case the joint was treated with massage and hot air, and the patient was now walking about without crutches, and with a constantly increasing amount of flexion of the knee.

#### THE ANATOMY OF SPINAL PUNCTURE.

DR. WILLIAM C. LUSK read a paper with the above title for which see ANNALS OF SURGERY for October.

# TRANSACTIONS OF THE PHILADELPHIA ACADEMY OF SURGERY.

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*Stated Meeting held April 3, 1911.*

## PERFORATING ULCER OF THE SIGMOID FLEXURE OF THE COLON.

DR. GEORGE G. ROSS gave the history of a woman, thirty-five years of age, who was admitted to the Germantown Hospital in a condition of profound shock, with a rigid, tender, and distended abdomen. Symptoms had been developing but a few hours, patient having been awakened during the preceding night by pain in the lower abdomen and nausea.

An incision into the peritoneal cavity was made through the right rectus muscle. As soon as the peritoneum was incised, a gush of rather thick, yellowish fluid came forth, bringing with it lumps of hard fecal matter. There was marked redness over all peritoneal surfaces of the lower abdomen. At this point the etherizer gave notice that the patient's condition was critical. She was cyanosed, pulse uncountable, and respiration suddenly became irregular in both rate and rhythm. The operation was started under primary anæsthetic and had been under way for about five minutes. Ether had to be discontinued on account of the patient's condition. A glass drainage tube was inserted into the pelvis, and the wound closed with three through-and-through silkworm gut sutures. The patient was given an intravenous injection of normal salt solution while still on the operating table. She died about twelve hours later.

Immediately after she died, the stitches were cut, the tube removed, and a search made for perforation of the large intestine. This was considered as necessarily present, as the patient had solid fecal matter free in the peritoneal cavity. Eventually the perforation was found about the middle of the sigmoid flexure of the colon on the inner or the right side, about one inch from the mesosigmoid. The perforation was almost perfectly circular and large enough to admit the thumb of a medium sized hand up to the distal joint.

The entire colon from the ileocæcal valve to the site of the perforation was impacted with fecal matter of the consistency of



hard putty. There was no evidence of active tuberculosis, although there was one calcified mesenteric gland found.

#### CARCINOMA OF THE APPENDIX.

DR. GEORGE G. ROSS reported the history of a man, aged thirty-five years, who was operated upon for chronic appendicitis. When the appendix was exposed, it was found to be bound down by adhesions, and about its middle there was found a small mass about the size of a small pea and in appearance not unlike a caseous tubercle, bulging from the serous surface. Adjacent to the appendix, in the mesentery of the small intestine, there was found a mass of lymph-nodes, hard, densely adherent, about one inch in diameter, and about three inches in length. Smaller nodes were palpable in different localities of the peritoneum. The appendix was removed, the stump buried with a few linen sutures, and the abdomen closed in layers without drainage. A small amount of serous fluid was noted in the peritoneal cavity.

The stitches were removed on the sixth day. The incision healed nicely. The patient was discharged on the tenth day. One week later he was readmitted complaining of severe abdominal pain and diarrhoea. Examination revealed that the mass in his abdomen had increased rapidly in size, and that a mass in about a corresponding position under the left rectus was palpable. There was felt also a small mass in the abdominal wall, precisely under the left half of the umbilicus and extending to the left for about one inch. This mass was apparently about one inch in diameter. A section of it was removed for study. The abdomen on this admission was very tense and contained free fluid. Pain was very severe, requiring morphine.

*Pathological Report on Appendix.*—Dr. Bradbury reported as follows: Small nodule about two mm. in diameter, bulging from about the middle of appendix on serous surface. Microscopic examination revealed this to be a carcinoma simplex, not involving the mucous coat.

The nodule removed from abdominal wall was also reported to be a carcinoma simplex.

#### COMPOUND COMMINUTED FRACTURE OF THE FOREARM.

DR. GEORGE G. ROSS presented also a man who had sustained a compound comminuted fracture of both bones of the forearm, the result of an accident in a gymnasium. When seen by Dr. Ross two weeks after the accident, there was absolutely no union.

both bones were badly involved. After waiting another week in order to give the fragments time to harden up, he then cut down on the radius and wired it with heavy silver wire. Nothing at all was done to the ulna. In six weeks the patient was playing the pipe organ.

#### TUBERCULOUS ARTHRITIS OF THE ELBOW.

Dr. Ross presented a man, saying that he was operated on originally by Dr. Deaver, who took out a portion of the elbow-joint. Some time after that there were persisting sinuses, with extensive necrosis of the heads of the radius and ulna and end of the humerus. Dr. Ross resected the ends of all three bones, and interposed superficial fascia between them. Patient now has a very good joint; all ankylosis has disappeared.

#### POSTERIOR GASTROJEJUNOSTOMY DONE TWO YEARS AFTER OPERATION FOR PERFORATING GASTRIC ULCER.

Dr. MORRIS BOOTH MILLER presented the man whose case was detailed by him at the meeting of February 1, 1909. Operation was done nine hours after perforation, and after a stormy convalescence there was apparently a perfect recovery. He was well for some weeks, but then commenced to develop gastric symptoms again, which, continuing, made it necessary last January to do a formal gastrojejunostomy. He illustrates the point which Dr. Deaver made at the meeting referred to, namely, that in these cases a gastrojejunostomy should have been done at the primary operation. However, Elliot has called attention to the fact that certain cases get well and stay well without that operation. This patient from the secondary operation made an easy recovery, and has had no subsequent trouble.

Dr. HENRY R. WHARTON said that he thought that in the majority of cases the patients are in poor condition for any prolonged operation, and as to the fact that doing a gastro-enterostomy at this time does not always prevent a second perforation, he recalled a case of perforated gastric ulcer occurring in this city upon which Dr. Deaver operated and at the same time did a gastro-enterostomy; a year later the patient had a second perforation, which Dr. Wharton closed; a little over a year after the second perforation, the patient had a third perforation, for which he has recently been operated upon. As regards the question of doing a gastro-enterostomy at the time the perforation is closed, this is a matter upon which there is some

difference of opinion among surgeons; one of the first cases he operated upon for ruptured gastric ulcer, which was closed six hours after the perforation, has remained well up to the present time, simple closing of the perforation in this case being followed by a permanent cure.

With regard to the liability to second perforation, this is always a possibility. He operated about a month ago upon a case of perforated gastric ulcer, who at the time, about sixteen hours after the perforation, was in very desperate condition. He found the perforation, closed it, and the man did well for nineteen days, then he had a vomiting spell and a second perforation occurred which was closed twelve hours after the first symptoms. The patient only lived eight hours after this second operation.

DR. GEORGE G. ROSS reported the case of a man about fifty years of age who had a perforated duodenal ulcer, who was operated upon in an hour and a half after the onset of pain. In this case he would have certainly done a gastro-enterostomy had the patient's condition warranted, but by the time the perforation had been located and was closed the etherizer reported the man as about dead. He therefore did not think he was warranted in doing a gastro-enterostomy, but all his efforts were given to resuscitate the man, who finally recovered, and the wound was closed with pelvic drainage. A week later patient had a recurrence of symptoms, and from these he finally died. A postmortem showed an ulcer, horse-shoe shaped, an inch and a half long. The primary perforation which Dr. Ross had closed was in the stomach end and the second perforation was in the duodenal end. There were four other ulcers on the posterior wall of the duodenum. Had a posterior gastro-enterostomy been done the man's life might have been saved, but under the circumstances he did not feel warranted in prolonging the operation.

DR. JOHN H. JORSON recalled the case previously reported by him before the Academy, of perforated pyloric ulcer, operated upon two years ago last November, it being one of five cases upon which he had operated. This patient entered the hospital just two years after the original operation for perforation, and he did a gastro-enterostomy for a recurrence of symptoms of ulcer and pyloric stenosis. Since then patient has remained well.

#### EVISCERATION THROUGH STAB WOUND IN ABDOMEN.

DR. MORRIS BOOTH MILLER reported the history of a man, aged twenty-five years, who was admitted to the Polyclinic Hos-

pital on October 8, 1909, soon after having received a stab wound of the abdomen. In the right lower quadrant was a clean-cut wound six inches or more in length, which extended through the entire parietes. It commenced about two inches above the anterior superior iliac spine, and went downward and inward toward a point midway between the umbilicus and the pubes. From it protruded enough coils of small intestine to more than fill the crown of a Derby hat. This mass had not only been contaminated by contact with the clothing, but it was also covered with intestinal contents exuding from coincidental perforations of the gut.

He was immediately taken to the operating room and etherized, his clothing was removed, and the character and extent of the wound was examined. Absolutely no attempt was made to cleanse the abdomen, as to have done so would have involved the replacement of the infected viscera within the abdomen. Instead of the usual scrubbing, the adjacent skin, including the edges of the wound, was covered with several layers of wet towels. The bleeding was traced to the deep circumflex iliac, a vessel in this patient of unusual size and capacity. It was controlled by ligation. There were three intestinal perforations, the largest of which was three-fourths of an inch long; two were about an inch apart, and the other some distance away. These were turned in and closed with Lembert sutures of silk. In addition there was a two-inch slash in the mesentery close to the intestinal border, which was also closed with silk. The toilet was completed by a very thorough and copious flushing with warm normal salt solution, care being taken to remove without insult to the peritoneum all unclean particles as far as possible. The mass of intestine was then returned to the abdomen, and the wound closed with tier sutures of catgut. Drainage was accomplished by the means of two split rubber tubes, one going through a median stab wound down to the rectovesical space, the other passing into the right flank, while close to these were placed two or three superficial wicks of gauze.

The patient was put in bed in the semisitting position of Fowler, and continuous enteroclysis was instituted. He reacted well, but during the night was restless and vomited a considerable quantity of semidigested food. During the night two coils of intestine again escaped outside of the abdomen. He was again etherized, placed in the Trendelenburg position and the loops of gut returned. This time the abdomen was closed with through-

and-through sutures of silkworm gut, suturing the peritoneum with a separate catgut stitch.

The subsequent history was uneventful. There was some infection in the superficial layers of the wound which delayed complete healing, but there was no general peritonitis and no localized peritoneal reaction of any moment. He was discharged cured on the thirtieth day.

#### STAB WOUND OF CHEST.

DR. MILLER related the history of a man, aged thirty-nine years, who was admitted to the Polyclinic Hospital on January 20, 1911, suffering from a stab wound of the left chest. He was not appreciably shocked, but complained of intense pain in the thorax; temperature was 98°, pulse 42, respirations 18. He stated that immediately after being wounded he had some difficulty in breathing, but this was not appreciable when first examined. Within an hour after admission he expectorated a small quantity of bloody mucus, and soon after there commenced a hacking, spasmodic cough which persisted more or less until his death, fifteen days later. Between the seventh and eighth ribs and just in front of the posterior axillary line there was a transverse knife wound about half an inch long; in this neighborhood there was an area three or four inches in diameter, which was slightly emphysematous. As the wound entered the thorax after passing through an unusually thick cushion of muscles, it seemed hardly likely that penetration had been very deep. However, the patient told us that he had been stabbed with a dirk having a six-inch blade, and he thought it went in up to the hilt.

Examination of the chest showed restricted movements on the left side, slight dulness on percussion over an area the size of the palm, many fine and coarse râles, but it was clear that no lung collapse or extensive intrathoracic hemorrhage had occurred. The breath sounds toward the base were unimpaired. The slow pulse was noted, and the question of heart injury was considered. The cardiac area of dulness was not increased, both the sounds were clear, and aside from somewhat labored action there was nothing abnormal discovered. Despite the history, which pointed to a deep wound, it was thought that only the superficial portions of the lung were involved. The chest was immobilized with adhesive plaster, and quieting doses of opium were administered.

For twenty-four hours his condition seemed satisfactory and he made no complaint except of the hacking cough. On the

twenty-second the temperature suddenly shot up to 104.8. Even with this fever there was no marked or, indeed, proportionate increase in the pulse or respiratory rates, the pulse being about 100 and respirations 24. Examination of the chest showed a widened area of dulness, five or six inches in diameter, over which distant bronchial breathing was heard. It was apparent that there was some pneumonic consolidation. Expectoration was profuse and rusty brown in color. Leucocytes numbered 16,300.

In long remissions which gradually decreased, his temperature fell to about normal on the twenty-ninth. By this time the external wound had completely healed and all the emphysema had disappeared, but the area of pulmonary dulness remained the same in size, and physical signs were unchanged. Expectoration was still free, but its brownish, blood-tinged character had entirely cleared up. The patient looked well, slept well, and made no complaint of pain or discomfort.

On February 1 he was transferred to the service of Dr. John B. Roberts, who has supplied the subsequent data. On that day his temperature rose in the afternoon to 103°, to fall to normal the next morning, and thereafter to run slightly sub-normal until the end. For the first time he commenced to show signs of respiratory distress and wanted to sit up in bed. With a quickened respiratory rate the pulse remained relatively slow and gradually grew weaker. It was soon realized that his condition was rapidly becoming critical, but the explanation was not so clear.

The patient continued to grow worse and died early on the morning of February 4.

At autopsy the pericardium was found to be greatly distended and incision into it was followed by the escape of fluid under great tension, this fluid being cloudy, yellowish brown in color, purulent, containing a large amount of fibrin, and probably measuring from one to two litres in amount. The pericardium and epicardium were covered with a thick deposit made up of fibrin and detritus. It was impossible to determine the presence of a wound extending into the pericardium from the lung.

Examination of the left pleural cavity revealed a general adhesion of the parietal and visceral pleuræ everywhere, so that it was necessary to remove the pleuræ with the lung in exposing the latter. At the position of the external scar the course of the punctured wound could be followed through the chest wall, pleuræ, and lung to a point possibly about 3 cm. from the

external surface of the latter. Corresponding to the position of the punctured wound the pleuræ were separated from each other by an organized blood-clot, over an area of about 15 cm. in diameter and about 1.5 cm. to 2 cm. in thickness. There was no sign of suppuration to be found in the pleural cavity or the lung.

#### FRONTAL ENCEPHALOCELE.

DR. MILLER presented photographs (see Fig. 1) of a five-days' old baby who was referred to him from Dr. Hamill's clinic at the Polyclinic Hospital on March 15, 1911, suffering from frontal cephalocele. According to the nurse the mass had been the size of a small tomato at birth, and not unlike that vegetable in color and shape, but it quickly commenced to shrink and dry on its surface so that when seen it was a brownish, ulcerated, somewhat foetid mass  $2 \times 1\frac{1}{2}$  inches in area with an elevation of about an inch. It was located over the glabella and spread broadly over the nose; while the eyes were partially covered by the mass they were not affected. The base was broad and appeared to be more on the left side, so that it was diagnosed as of the naso-orbital type in contradistinction to the nasofrontal or naso-ethmoidal forms of frontal cephalocele. There was no pulsation, no fluctuation, and no difference in size was noted when the child cried.

According to Von Bergmann, whose classification is now generally accepted, any congenital protrusion of intracerebral contents through a defect in the skull may be termed as cephalocele. The defects through which these protrusions take place are either frontal or occipital, except very rarely a defect between the sphenoid and ethmoid may give rise to one which appears in the pharynx. These defects are at or close to the median line, though the visible protrusion may be slightly to one side.

Frontal cephaloceles are divided as follows: nasofrontal, those in the region of the glabella; naso-orbital, those at the inner angle of the orbit; naso-ethmoidal, those below the nasal bones. Occipital cephaloceles are divided as follows: superior, where the defect is above the external occipital protuberance and where it may join the posterior fontanelle; inferior, where the defect is below the external occipital protuberance and where it may join the foramen magnum.

Cephaloceles occur in three forms, of which hydrencephalocele is the parent type, and encephalocele and meningocoele represent retrograde changes from it. Hydrencephalocele consists of arch-

noid, a layer of brain tissue, and a cavity containing cerebrospinal fluid derived from the lateral ventricle with which it communicates. It is really a hernia of the lateral ventricle. Covering it are fascia and skin, the latter sometimes natural and sometimes so altered as to be scarcely recognizable. The dura and pericardium do not extend beyond the margins of the bony defect. Encephalocele is a protrusion of brain substance covered by arachnoid. There is no fluid in this form, save, rarely, where there may be a superficial cyst of the arachnoid. It only occurs in the nasofrontal region. In meningocele all brain tissue is absent. Beneath the arachnoid is a layer of cells of the same type as those lining the ventricles, but the communication with the ventricles is almost or completely cut off. In other words, a cyst forms in the subarachnoid tissue, and thickened pia surrounds the cyst. In no form of cephalocele does the dura play any part.

#### CONGENITAL SACROCOCCYGEAL TUMOR.

DR. ALFRED C. WOOD made some remarks upon the classification and pathology of congenital sacrococcygeal tumors as a preface to a report of a recent case, as follows:

A female child, two months and ten days old, was seen by him at the Charity Hospital, Norristown, Pa., in consultation with Dr. Charles H. Mann, and the family physician, Dr. George F. Hartman of Port Kennedy. Dr. Hartman furnished the following data: The child's father is twenty-three and the mother twenty years of age; both are healthy. The patient was the second child, the first being entirely normal. The labor began at 2 P.M., July 12, 1910. The head and shoulders were delivered at 3 A.M., July 13. Dr. Hartman was called at 10.15 A.M., and the delivery completed with great difficulty. A tumor was then observed attached to the sacrococcygeal region, measuring  $19\frac{1}{2}$  inches in circumference, and  $18\frac{1}{4}$  inches from the base anteriorly to the base posteriorly (Fig. 2); this subsequent to the birth gradually increased in size and the child became more emaciated.

The tumor was globular in shape; the overlying skin was very thin, but otherwise normal in appearance. The surface was somewhat irregular in contour, the larger portion having the characteristics of a cyst on palpation, but here and there small areas were felt that were firmer, and apparently solid. The coccyx could be felt on the posterior surface. It was curved backward instead of forward in the normal manner, and a firm,



FIG. 1.

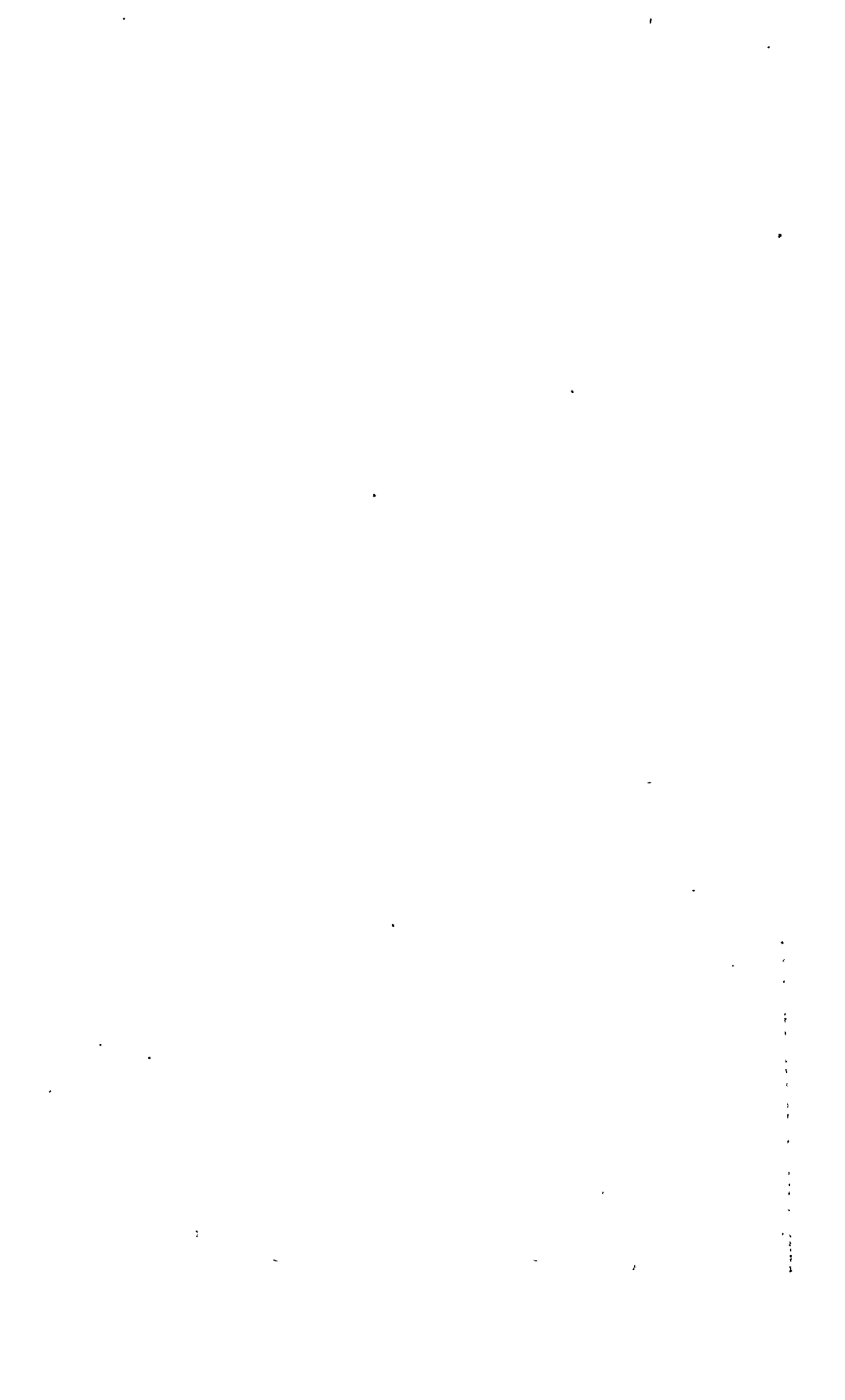


Frontal encephalocele.

FIG. 2.



Lumbosacral encephalocele.



narrow body like cartilage could be traced for some distance from its tip. The anal orifice presented on the anterior surface and was directed forward. The tumor evidently had its origin within the pelvis; it had no connection with the spinal canal.

As the tumor was enlarging and the child failing, it was decided to operate at once. Ether was administered, transverse elliptical incisions made, and the cyst enucleated. The cyst wall was closely adherent to the rectum from the anus to the level of the promontory of the sacrum, and some time was consumed in effecting its separation, which was finally accomplished without wounding the bowel or opening the peritoneal cavity.

When the incision was sutured, the anal orifice was drawn back into approximately its normal situation, and the general appearance was nearly natural. The operation was not accompanied by any severe hemorrhage, but the amount of oozing from the innumerable points of the large wound was probably greater than appreciated. The child appeared to be in satisfactory condition when it left the table, but death occurred a few hours afterward. Before the operation the child weighed 15 pounds and some ounces; after operation it weighed less than 7 pounds.

The tumor was composed of one large cyst, with thick walls; here and there areas of increased thickness were noted, some of which were small cysts, others were solid. The fluid was practically clear. Unfortunately, no minute study of the specimen was made.

DR. JOHN H. JOPSON reported the case of a girl about fifteen years of age, who had grown up with this condition, had attended school, had her clothing modified to make it as inconspicuous as possible, and had even ridden a bicycle. The reason her parents sought surgical advice was because one of the cysts had become infected. He aspirated one cyst and drew off considerable fluid. The growth was almost as broad as the buttocks, and rested on the thighs as far down as the knees. Excision was indicated and was suggested, although the operative risks would have been great.

DR. WILLIAM J. TAYLOR said that in consultation with Dr. Mary Griscom he recently saw a child a little over two months of age with a tumor very similar to that described by Dr. Wood. It measured  $2\frac{1}{2}$  inches in diameter. As the child was apparently in perfectly good condition, and the mother very anxious to have something done, the child was etherized and he related the

Griscom in the operation. The tumor was removed with little or no difficulty. On examining the tumor after its excision he found that there were portions of the coccyx and little cartilaginous masses through it. It was partly cystic, partly fat and fibrous tissue, and partly, he believed, sarcomatous. He did not dissect it carefully as he wished to hand it over to the pathologist, who now has it for examination.

Although directly next to the anus, the wound has healed by primary union. (Since the meeting Dr. Taylor has learned the growth was a teratoma.)

#### PARAFFIN INJECTION AS A CURE FOR INGUINAL HERNIA.

DR. ALFRED C. WOOD presented a specimen which had been removed from the inguinal region of a man aged fifty-five years. The patient was seen in consultation with Dr. S. H. Scott and Dr. Jackson Taylor of Coatesville, Pa.

The man stated that two years ago he had been induced to submit to an injection for the cure of a right inguinal hernia from which he had been suffering. Immediately after the injection, he noticed a large swelling in the neighborhood of the external ring, which has since persisted. The hernia was partially controlled, as it did not descend beyond the upper part of the scrotum afterward. The mass was about the size of a hen's egg, was freely movable, and could be pushed through the external ring into the canal with ease. The overlying skin was normal in appearance. One of the most annoying features according to the patient was the extreme mobility of the lump, which he said caused much more inconvenience than the hernia ever did. During certain muscular efforts, such as coughing, etc., the mass would be drawn up into the canal and forcibly projected downward. This action was plainly shown during the stage of etherization when the patient was breathing deeply; the lump moved upward into the canal and down like a shuttle with each respiratory cycle. The mass was excised. It was found to be in the loose connective-tissue layers of the cord and outside of the sac of the hernia. A capsule had formed by condensation of the connective-tissue layers about it. The sac of the hernia was removed, and the operation concluded according to the Bassini method for radical cure. Recovery was uneventful.

The specimen measured  $5.5 \times 4 \times 3.5$  cm., and on section was found to consist entirely of paraffin.

## CORRESPONDENCE.

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### VESICOVAGINAL FISTULA FROM PENETRATION OF FLOOR OF THE BLADDER BY HORN OF A BULL.

HATTIE M., a white girl, sixteen years of age, a patient of Dr. W. W. Wharton of Thomas, Ala., was referred to me April 22, 1910, with the following history: When about eight years of age she was gored by a bull, the horn entering the vagina and lacerating the sphincter ani and tearing the urethra open, the rent extending back into the bladder for several inches. She was living in the country at the time, and was attended by her family physician who attempted to suture up the wounds. She was confined to bed for about six months. Since the injury the urine has flowed out through the vagina, and her whole existence has been very miserable. She has some control of the bowels. Her general health is good.

Menstruation began about two years ago and has been regular and normal. By constant care she has been comparatively free from excoriation from the urine.

In the past few years several unsuccessful attempts have been made to close the bladder.

On admission to the hospital the urethra was found completely severed below and the defect extends back through the bladder and anterior vaginal wall for about two inches; three fingers can readily be passed into the bladder; the cavity of the bladder is large and seems to be about normal in size; the tissues about the urethra are retracted but moderately well developed.

The urethra and bladder were dissected up from the vaginal wall for about a quarter of an inch on either side well back beyond the inner end of the tear; the free edges of the bladder were turned up into the cavity of the bladder and brought together by a running mattress suture of No. 1 chromic catgut, beginning posteriorly and working forward; this suture completely closed the bladder and gave a good approximation of the ends of the sphincter of the bladder; this was reinforced by passing shotted silkworm gut sutures through from the vaginal side to the bladder only, turning the free edges of the vaginal mucous membrane into

the vagina; by this method of suture we had practically half an inch of freshened surface for union.

A soft rubber catheter was kept in the bladder for a week and was then removed and passed every three hours for a few days, when she began to void, having complete control between times.

The silkworm gut sutures were removed on the fourteenth day. She was kept in bed for a few days, and was then allowed to get up and go home.

She has had absolute control of the bladder since operation, and is in perfect condition a year after operation.

GASTON TORRANCE,  
Birmingham, Ala.

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# ANNALS OF SURGERY

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## ORIGINAL MEMOIRS.

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### SOME CONSIDERATIONS IN THE TREATMENT OF FRACTURES OF THE LONG BONES.\*

BY RICHARD H. HARTE, M.D.,

OF PHILADELPHIA.

Associate Professor of Surgery in the University of Pennsylvania; Surgeon  
to the Pennsylvania Hospital.

THE question primarily is: Are we obtaining the most desirable results in the treatment of fractures of the long bones, in view of the appliances at our command in the way of aseptic technic and the unlimited advantages of the Röntgen laboratory, which to-day form an essential part of the armamentarium of our modern hospitals?

I cannot help feeling that we, as surgeons and teachers, are not fully utilizing our talents nor all of the advantages at our command. Neither are we devoting as much time and care as we should to the thorough instruction of students and internes in our schools and hospitals in this very important branch of surgery. Many at first may be disposed to question this statement, but I hope to elicit your thoughtful consideration of what, to my mind, seems most important.

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\* A part of the Presidential address before the American Surgical Association, June 19, 1911.

There is lack of interest and a feeling that the subject of fractures is so old that it will almost take care of itself. To-day other fields of surgery—for example, the abdomen, blood-vessels, and thorax—offer such a large and attractive variety of opportunities for original research and investigation, and the results are so brilliantly and quickly achieved, that it does not seem strange that the slow physiological processes pertaining to the repair of a broken bone should be relegated to the care of those whose time is less occupied, and who are willing to accept this responsibility of what they have been taught to consider a very humble and almost unimportant branch of surgery.

Teachers and surgeons generally appear to be apathetic, and are disposed to leave these cases to the care of assistants or house officers, and it is only after a case has progressed badly that sufficient interest is aroused to demand action on the part of the surgeon.

Not only is less time given to teaching this important and interesting subject, but the study of the clinical aspects of the case, which was thought so essential formerly for a correct diagnosis, has given way to the more easy laboratory findings. The student of fractures to-day feels that an X-ray report will reveal to him in a moment, and with less trouble, what a careful clinical study, requiring a much greater expenditure of time, would show.

Permitting this impression to grow in the minds of students has had its influence indirectly upon the treatment of fractures in general, and it is only too apparent that the rising generation is lacking in much of the skill and resourcefulness which characterized the older surgeons in the diagnosis and treatment of these injuries.

The older Fellows well remember how much time, care, and attention were formerly devoted by lecturers to the consideration of fractures; they formed, in fact, one of the most important topics in a course on surgery, which always embraced a very complete classification *of* and exhaustive instruction *in* the mechanism of fractures, the displacing element



played by the muscles, and what should be done to obviate and correct these displacements; and practical instruction looking to acquiring a thorough knowledge of the art of bandaging and how to apply accurately all forms of fracture dressings, first in the bandaging of mannikins, and later on of human subjects, so that the student was able to properly apply all sorts of roller bandages. He would have them applied to his own person and so form an accurate conception of the amount of pressure that is necessary to retain a splint to the injured part, or to control the spasms of an irritated or bruised muscle. Thus equipped and informed, the young surgeon, no matter how youthful his appearance, was able to convince his patients that he was at least master of this branch of surgery.

Contrast this with what we see in so many of our house officers to-day, many of whom have been appointed after a most vigorous competitive examination, in which they may have displayed enviable knowledge of bacteriology and hæmatology, and may have been able to cite quite glibly all of the intricacies of the Wassermann reaction, but who have hardly the slightest idea of how a splint should be padded or prepared for a fracture of the forearm, much less exactly how it should be applied; and (what is infinitely worse) when instructed, will invariably relegate this important part of the routine treatment of fractures to the ward nurse, who may be but little more advanced than the probationer.

It would appear to the careful observer that the surgeon of to-day depends too much upon laboratory findings, and that a careful clinical study of the aspects of a case is too frequently neglected.

For the X-rays, it must be said that our knowledge of fractures appears to have been limited before the year of its development, and, as the natural result of this marvellous invention, to have enormously advanced and the entire subject to have been transformed so that we have a new generation growing up who cannot consider fractures except in the light of a skiagraph, nor tolerate anything which partakes of the nature of the older methods of diagnosis.

Good X-ray work has been done in the last decade, adding much to the data on the subject of fractures, demonstrating that fractures occur in types—and very definite types at that. It has proved that many types which were supposed to be rare are common, as comminuted fractures of the lower end of the radius, fracture and luxation of the carpus, and fracture of the greater tuberosity of the humerus. It has disproved the prevalence of such injuries as coracoid fracture of the scapula and fractures of the acromion process.

It has placed and classified fractures about the elbow-joint, especially in children, and has demonstrated many of the injuries to be of an epiphyseal nature and not of the type of T-fracture so often seen in adults.

Thus, in teaching us *what* to look for, it also has, or should have, taught us *how* to look.

I do not wish for a moment to decry the use of the X-ray, but to consider the time and place for its employment. Much has been said about the importance of having every case skiagraphed for the purpose of making a diagnosis, and about its being criminal to omit the picture. To my mind, it is often unnecessary and impracticable, and may often inflict considerable hardship on the patient of limited means. It does little more than satisfy a certain curiosity without really adding data for the future management of the case. Of course, in obscure and special conditions, a preliminary skiagraph may be profitably employed, and should be. The X-ray in all its phases will prove an invaluable aid to study, a condemning judge to the careless surgeon, and a constant and inspiring stimulus to improved technic.

The time for the X-ray picture is after a thorough clinical study and accurate reduction have been made under an anæsthetic (if necessary), and appropriate dressings placed on the injured part. The skiagraph can then be taken, not primarily for the purpose of diagnosis, but for the assurance of an accurate and proper coaptation of the fragments.

In other words, the time to employ the X-rays is preferably after and not before reduction, thus acting as a check to diagnosis, correction of position, and prognosis.

I wish to emphasize the importance of having fractures skiagraphed in planes crossing each other at right angles, or else of having a stereopticon plate prepared, which is of great advantage. Otherwise many fractures will escape detection and leave the surgeon only clinical data for the future management of the case, which will be very embarrassing to the man who places absolute confidence in the result of his X-ray findings.

I feel that a general review of the subject cannot be dismissed without some reference being made to the so-called open treatment of simple fractures, as advocated by some of the more radical members of the profession, and so strongly advised by Mr. Lane, of London, and Dr. Huntington, of San Francisco.

In this respect, medical men to-day seem distinctly divided into three groups:

1. Those who never or rarely ever operate at all, who may be called the ultraconservatives.
2. Those who operate on nearly every case, who might be designated as extremists in this branch of surgery.
3. The conservatives, who operate on properly selected cases, after it is definitely proved that other methods of treatment are not expedient and that proper reduction cannot be accomplished nor the ends of the fragments held in position without some operative procedure.

From the first group, we get the greatest number of distinctly bad results and the largest number of suits for malpractice.

From the second group, if uniformly followed, we would undoubtedly have the greatest mortality.

From the third or more conservative group, we have, I think, the best results consistent with a low mortality.

The operative or open treatment of simple fractures is, in itself, a very large subject in which many things have to be

considered beyond the mere approximation of the ends of the bones and their permanent retention by some mechanical device, as catgut, tendon, wire, nails, plates, etc., and should only be considered for a class of patients that give promise of being good operative risks.

And, before going further, I want to pay tribute to the very excellent pioneer work done in this city (Denver) by our late colleague, Dr. Parkhill, who devised some ingenious clamps and screws for retaining in position the fragments in fractures of the long bones. His method has been slightly modified by some, but the far-seeing underlying principle still remains the same, and offers a very satisfactory and safe method for dealing with certain types of fractures demanding operative interference.

It stands almost without reasoning that, in order to obtain a good functional result after fracture, the ends of the bone should be brought in direct relation with each other, and most of the cases in which we fail to obtain union are those in which the fragments are widely apart and not infrequently separated by a fragment or spicule of bone, a tendon, a muscle, or piece of fascia. No satisfactory attempt at repair will take place until all barriers are removed by operation, the fragments retained in position by some mechanical device, and the limb kept at rest by means of suitable splints and bandages. Everything should be done to make the patient's physical condition the best, and, last but not least, the hygiene of the skin of the injured member should be kept in the highest state of efficiency by frequent ablutions of soap and water, alcohol, and light massage.

The time for operating, if found necessary, is either as soon after the injury as possible, and before the parts are infiltrated with serum and before muscular contraction has taken place, or after the inflammatory condition has subsided (which is usually during the second week). To wait longer involves much muscular contractions and adhesions, which add much to the technical difficulties of the operation. Moreover, distinct changes are occurring in the ends of the fragments,

which often tend to delay union by blocking up the bone channels with lime salts—a condition frequently seen, though oftener in cases of old ununited fractures.

I do not endorse the methods of my more radical friends who can hardly look at a fracture except in the light of an operation, and who use some form of metallic plate which is retained in position by drilling the bone and inserting screws, nails, wire, or some extraneous substance, for the following reasons:

If this entailed no risk or bad effects, this method would certainly offer all that could be desired, so far as the approximation and retention of the fragments are concerned. But by pursuing this method, as routine treatment, the patient has his simple fracture converted into a compound one (in itself always an element of risk). The ends of the fragments have to be dealt with rather vigorously by introducing screws for the plates, which have to be removed by a second operation, and the presence of these foreign bodies interferes with the bone's nutrition and frequently causes considerable necrosis and caries, which are disclosed at the time of their removal.

Before dismissing this branch of the subject, I wish to emphasize the importance of early operative interference in cases where the ends of the bones cannot be properly adjusted, or where there is danger of non-union, or where bad functional result follows the ordinary procedure. Where any of these conditions exists, the sooner the case comes to operation, the better for the patient.

It must be remembered that these operations are often most difficult, requiring a special type of instruments and a thorough surgical technic (which is not in the province of every man who considers himself a surgeon), and that the wounds are more prone than any other class of wounds to infection, and the risk to life and limb is thereby proportionately increased.

In conclusion, I want to try and bring to the minds of the Fellows of this Association the importance of more thorough instruction in the routine treatment of fractures in general by

men of large surgical experience, instead of relegating it to mere novices, because students are very astute and quickly grasp the relative importance of any subject by the class and character of men to whom its instruction is intrusted.

If this suggestion is faithfully carried out, a much smaller percentage of cases will be offering themselves for operation and less of our surgery will be reviewed in the courts for either real or imaginary lack of surgical skill.

# THE TREATMENT OF FAR-ADVANCED MALIGNANT DISEASE. \*

BY JOHN H. GIBBON, M.D.,

OF PHILADELPHIA.

Professor of Surgery in the Jefferson Medical College; Surgeon to the Pennsylvania Hospital.

ONE of the most perplexing and pathetic questions which confronts the surgeon is what to do for patients suffering from far-advanced malignant disease. We realize that the results obtained by early and radical operation are gratifying, and that it is only by such treatment that cures can be promised. It is obvious then that what we want is to have the patients come to us early and not as a last resort. Why do they not come early and why do they so often first consult the cancer quack? (I refer, of course, more particularly to the more ignorant class of patients, though such behavior is by no means rare among patients who consider themselves intelligent.) In order to answer this question I have asked many patients to explain their delay and their obvious dodging of the surgeon, and I have discovered that there is a wide-spread belief among the laity that surgery is of no avail in the face of cancer and that it should only be employed when other means of treatment have failed. Probably in no surgeon's office, and certainly in no surgical dispensary, is the following statement rare, "If it is cancer, I do not want it operated upon, but if it is a simple tumor I am willing to have it removed." On being asked to explain his attitude the patient tells us that he knows of several cases, often one or two in his own family, where recurrence took place promptly after operation. He does not understand that the operation was probably a late one, and draws his conclusions only from the result accomplished by the operation. Unfortunately the patient sometimes gets bad advice from his

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\* Read by title before the American Surgical Association, June 28, 1911.

medical attendant, who lacks courage enough to say as soon as the growth is discovered that a surgeon should be consulted and wastes valuable time in applying ointments and giving placebos.

Many general practitioners share the belief I have accredited to the laity that surgery is of no avail in the treatment of malignant growths, and this belief has its origin in the contemplation of early recurrences after late and incomplete operations. These practitioners are often forced by their own consciences or by the importunities of the patient to bring him for operation when the disease has advanced beyond relief. There can be no doubt whatever that this want of faith in surgery is prevalent in the laity and to a small extent in the profession, nor is there any doubt in my mind that it has its origin in the knowledge of the results obtained by operation in far-advanced cases. It seems to me, therefore, that as surgeons it is our duty to correct this false impression and substitute for it the truth, which is that cancer is curable if accessible and if operated upon early and thoroughly.

Many will say that we are certainly preaching this, and I admit it, but our practice very often counteracts the effect of our preaching. A poor patient presents herself, or is brought by her physician, with a far-advanced cancer of the breast with extensive glandular involvement, a condition which we recognize as being beyond operative relief, but out of sympathy for the sufferer, or with the vague hope that operation may relieve suffering or perhaps prolong life, or because the physician has told the patient she must be operated upon and persuaded her to consent, we operate, doing a most extensive removal of the original growth but finding too often that the glandular involvement is beyond removal, or worse, that metastasis to some other inaccessible part has already occurred. What is the result in such a case? The patient recovers from the operation, goes home, thinks she is cured, and she and her friends spread the news that she has been operated upon. In a few months the disease has killed her and all her friends and acquaintances make the natural deduction that surgery



cannot cure cancer. When one of these develops a similar condition operation is postponed until the same hopeless stage is reached and then operation is sought as a last resort. This, I take it, is the wrong way to teach the laity what surgery can do and thwarts our object—namely, that of getting the cases early.

Let us, for example, take this same type of case again and say honestly to the patient or her family and to her physician that the disease has progressed too far for operation. What will be the effect on the physician and on his patient of such an attitude? On the physician, if he is conscientious and honest, it will be that of stimulating him to bring his cases of tumor to us at an earlier date. The patient and her friends spread the news that she applied too late for operation, and she succumbs to the disease possibly a little earlier than if she had been operated upon. But the effect upon her circle of acquaintances is that when one of them develops a similar growth she will hasten to the surgeon lest she, too, may be told that the disease is beyond any hope of surgical relief. The public must be taught and this is one way we can do it.

It will be said that by this plan we are arbitrarily sacrificing the individual for the benefit of the race, because we cannot say how far the disease has advanced until we operate, and that occasionally cures are accomplished when least expected. I believe that with careful physical examination and thorough study of statistics we can pick out the cases which are apt to give us the pleasant surprises. We all realize that there are certain types of malignant tumor which grow slowly and metastasize late, and in such, even if far-advanced, cure or a long period of freedom from disease may be accomplished. But these are not the cases I would reject. On the other hand, we have types of carcinoma, like that of the uterus and the rectum, especially in young people where only early operation can be of avail. An examination of the liver through an abdominal incision has more than once saved me the chagrin of resecting a rectum for cancer when the liver was already extensively involved in the disease. We know that a slow-grow-

ing cancer of the breast in a woman past fifty years of age, even if the skin is extensively involved, gives often a fair operative result, and we know, equally well, that it is useless to operate on a far-advanced rapidly-growing breast cancer in a young woman.

My feeling in regard to this matter is that for extent and thoroughness operations for cancer have reached their limit, and our improvement in the treatment of this disease must come through impressing the public and the profession with the idea that malignant disease must be attacked early and radically if it is to be treated successfully, and that one of the ways of doing this is to avoid operation, except those of absolute necessity, in cases which our experience and judgment tell us are so far advanced that there is only a small hope of temporary relief. By declining operation in the hopeless cases we stimulate those physicians who refer their patients to us to greater effort at early diagnosis, and we impress the laity with the fact that it is an early operation which cures cancer. To operate upon a far-advanced cancer of the rectum, with probable hepatic metastasis, means an early death accredited to futile surgery, while to turn such a case down with the statement that it is too late throws the onus where it may rightly belong, on the patient himself or on the physician who may have been giving him his "favorite pile ointment" without having once examined the interior of the rectum. In how many cases of cancer of the rectum do we find that a recent operation for hemorrhoids has been done? Improvement in the treatment of these cases must come, it seems to me, by early and complete operation and not by carrying our already extensive operative procedures still farther. The following is an illustration of the point I would make and I am sure it can be duplicated in the experience of most surgeons. Last winter I was foolish enough, out of sympathy for the patient and because of the importunities of the husband, to operate on a rapidly-growing adenocarcinoma of the breast, which for six weeks had been daily "rubbed" by an osteopath, who told the patient that although the treatment might not cure her

it would put the parts in better condition for operation later. When I first saw her it looked as if the breast were the seat of an enormous abscess and the axillary and cervical glands were extensively involved. The suffering and distress were so great that I yielded to the hope that an extensive operation followed by X-ray treatments might, at least, bring relief. Recurrence took place in three or four months and the patient died in six or eight months. How many of the acquaintances of this poor woman do you think believe that she died because "surgery cannot cure cancer," how many do you suppose know of the previous treatment, and would not my refusing to operate, because of the previous maltreatment, probably have had a restraining effect in the future on the person administering it?

In checking fire dynamiting and counter-firing may be of avail sometimes, but the surest way is to put out the fire in the beginning and the same applies to the treatment of cancer.

# EXTIRPATION OF TUMORS OF VOMER THROUGH THE ROOF OF THE MOUTH.\*

BY CHARLES H. MAYO, M.D.,  
OF ROCHESTER, MINN.

TUMORS of the nasal and nasopharyngeal regions are of common occurrence, but fortunately most of them are benign in character. Adenoids belong to this non-malignant group and occur frequently in children. Later in life the fibromata and the much more numerous polypi are seen.

Many types of operations have been recorded for the removal of malignant diseases in the nose (sarcoma and carcinoma), nearly all of these operations being purely nasal procedures through the normal openings, and, peculiarly enough, the success of such procedures, often admittedly incomplete in the reported cases, is quite as favorable as regards freedom from recurrence as are the operations for simple tumors performed in the same manner.

Infection following those operations appears to be a factor in delaying recurrence, especially in malignant disease, although many of the cases were reported soon after the operation was completed. Undoubtedly intranasal operations skillfully performed may destroy or remove large tumors which spring from the pharynx, lateral wall, and septum.

There are tumors, endothelial and sarcomatous in structure, which develop in and destroy existing tissue, such as the vomer. No benefit will be derived in these cases from the use of the snare or forceps, which are the instruments commonly employed for the removal of intranasal growths.

The early symptoms manifested by tumors of the vomer are nasal obstruction and the consequent changes in the voice. The offensive discharges accompanying malignant disease of the nose are of late occurrence, and when the vomer is involved the discharge does not appear until the structure is destroyed or replaced by ulceration of the diseased growth. Local pain or deafness has not been a marked feature of these cases.

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\* Read before the American Surgical Association, June 19, 1911.

Abnormal thickness of the septum is noted, and when this extends anteriorly may be mistaken for septal abscess. The pain, elastic touch, and more acute condition of abscess, however, differ from the slower invasion of malignant disease. The posterior enlargement of the septum can be felt with the examining finger and seen with the reflection in a mirror. One of the reported cases developed a rigid thickening in the roof of the mouth beneath the vomer.

In examining tumors of the vomer, the pathologist should insist that the tissue removed for microscopic examination be deep enough to secure real tumor tissue which will show the characteristics of the growth, otherwise the specimen may show but normal, or at most inflammatory, mucosa.

Metastasis, as a rule, is a late symptom, and when it is present few patients can be improved in health or have their lives prolonged by radical surgery. In such cases the use of Coley's<sup>1</sup> toxins and, in addition, the ligation with excision of the external carotid arteries for starvation of the growth, as advocated by Dawbarn,<sup>2</sup> may prove of some benefit with or without local treatment.

With regard to the benefit to be derived from Coley's toxins: We believe that they are indicated in such cases of nasal malignancy, after the diseased growth has been removed by operation, and not, as has been done so often, reserve the procedure for inoperable cases only, or wait for a recurrence of the growth. In a few instances excellent results have been reported by injections into the tumor; for example, formalin, arsenic, alcohol, adrenalin, etc.

The methods of approach in removing nasal tumors other than by the anterior or posterior normal openings are as follows: Displacing the external nose and cartilage upward by an incision within the lip similar to the route advocated by Halsted<sup>3</sup> and Kanavel<sup>4</sup> in the approach to the hypophysis. In order to secure additional room the upper jaws may be divided and separated, to be reunited by wire or splint, as advocated by Gussenbauer<sup>5</sup> for removal of nasopharyngeal growths. Many operations through external incision have been advocated: lateral incision, turning the nose over to use

side (Loewe<sup>6</sup>), horseshoe incision on both sides and across upper bridge, turning the nose down, are some of the methods recommended.

Boeckel's<sup>7</sup> angular incision at the side of the nose, opening the nostril and extending outward beneath the eye, gives good exposure. By extending the incision to the eyebrow past the internal canthus the operation is converted into that of Moure's<sup>8</sup> which is of value when more room is desired and is much less mutilating than most operations through an external excision.

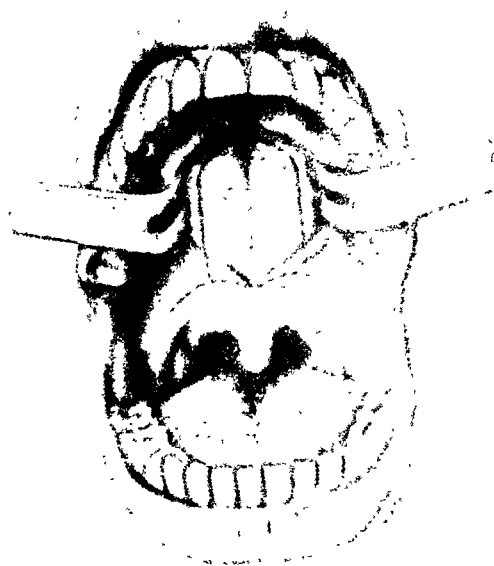
In operating through the mouth, Nélaton<sup>9</sup> makes an incision in the midline along the hard and soft palates with resection of the bone. The soft palate is completely divided.

In two cases of malignant disease of the vomer, each with a pear-shaped enlargement of the septum which completely closed the posterior nares, we were able to remove the growth through the roof of the mouth by the removal of a section of the bone one inch long and three-fourths of an inch wide. In neither of these cases was it necessary to sever the soft palate as advised by Nélaton—a procedure which complicates the technic of the operation and the after care of the patient.

In preparation for the operation, it is advisable to give the patient 30 to 50 grains of urotropin 24 to 48 hours preceding the operation, as it undoubtedly aids in preventing meningeal infection. In the two cases which were operated in our clinic at St. Mary's Hospital, the patients were given ether to profound anæsthesia following the preliminary hypodermic of 1/150 grain of scopolamine and ¼ grain of morphine, given two hours before operation to secure the full effect of the scopolamine.

The resection of the central posterior half of the hard palate is made by midline incision with preservation of the mucoperiosteum and soft tissues. The position of the patient being the reverse Trendelenburg, at this stage of the operation, the head of the table is lowered with the head back in the Rose position, which prevents the blood from aspirating into the trachea. The septum is rapidly removed with bone cutting scissors and curette, and the space packed with gauze. The hemorrhage is

FIG. 1



Bone removal. Tumor of upper.

FIG. 2.



Tumor of upper jaw.





quite free during the operation, requiring constant sponging or a sucking apparatus for its removal. The primary gauze pack may be removed within a few minutes and the area of superior attachment of the vomer cauterized with a Paquelin. The nasal space is then packed with benzoated gauze, which is removed on the third day. According to the extent of the disease, some cases may be treated best by immediate suture of the mucoperiosteum, as in a cleft palate operation, while in others it may seem best to maintain the opening, for a time at least, for observation and treatment. Both of these methods were followed in the cases reported herewith.

CASE A41472.—Mrs. H. A. C., aged fifty-six years. Examination July, 1902. Nasal obstruction, and change in voice, due to the condition. Diagnosis: tumor in vomer area. Operation, Jan. 29, 1903: Resection of bony palate in roof of mouth. Preservation of soft palate. Removal of vomer. Cautery to area of superior attachment. The opening left for observation was covered by plate with teeth which the patient wore. Pathologic report: sarcoma.

Patient remained well seven years, then died of carcinoma of the intestines following an illness of several months.

CASE A49321.—E. McD., male, aged sixteen years. Examination Feb. 15, 1911. For five months has had discharge from the nose with obstruction. Tumor occupying vomer area. Diagnosis: sarcoma of septum. Operation, Feb. 25, 1911: Removal of tumor through roof of the mouth. Bony resection with preservation of soft palate. Pathologic report: fibrosarcoma.

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- <sup>7</sup> Boeckel: Bryant's Operative Surgery, vol. i, p. 657.
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- <sup>9</sup> Nélaton: International Text-book of Surgery, Warren-Gould, vol. ii, 1900, p. 23.

# **PYLOROPTOSIS; GASTRIC ATONY AS THE ORIGINAL CAUSE OF NEURASTHENIA, AND ITS CURE.\***

**BY ARCHIBALD MACLAREN, M.D.,**

**AND**

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LESS than one year ago we decided to make a series of X-ray investigations of the stomach, to determine its size, position, and motility. As the digestive act is always performed while the patient is in the upright position, we decided to take pictures while the patient was standing. In these pictures a preparation of bismuth oxychloride has been used, because it has been demonstrated that the gastric secretions have no chemical action on this form of bismuth, and the influence of the normal acidity on the pyloric contraction is therefore present, and, most important, there is no danger of poisoning when using this drug. We were surprised to find that all of our pictures showed the stomach hanging vertically down in the abdomen, hung from the œsophageal opening, slightly curved to the right at the bottom like a big letter J. (Fig. 1). The anatomical description of the stomach as usually given is correct when the patient is lying down, but gives no idea of the great range of motility of the organ. The anatomists have been working at a great disadvantage, because they have been studying the stomach in post-mortem specimens. It must be remembered that a living stomach is different from the dead flaccid sac seen in the post-mortem room. Surgeons, too, have been at a disadvantage, because they have studied this organ when the patient was supine, lying on the operating table. We can also readily see that the administration of an anæsthetic with its consequent nausea would probably change not only the position of this organ but also its shape. The pyloric end is described as usually crossing the spinal column at the first lumbar vertebra, and this is

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probably true when the patient is supine, but when in the upright position we find it frequently crossing at the fifth lumbar.

The ordinary method of determining the position of the stomach in the abdomen is by inflating it with gas or air, but we can readily see that inflation would make the organ rise in the abdomen, much like an inflated bladder in a barrel of water.

Hallings showed some time ago that the stomach is supported by the intestines and that they have in the abdomen about the same specific gravity as water.

In the pictures of all of these stomachs it is noticeable that there is a constriction of the circular fibres about half way between the pylorus and the fundus, giving an hour-glass effect, and while we cannot demonstrate any increase in the circular muscular fibres at this point, it is possible that this may in some way be related to the antral sphincter, which divides the stomach in half, in lower animals. Several observers have, we believe incorrectly, described these normal stomachs as hour-glass deformities.

Early in our investigations we found that many stomachs were very markedly prolapsed but that their owners had perfect digestions. Gastropsis without symptoms was an explanation offered, but when we found that most healthy women and many healthy men had stomachs hanging well into the pelvis, we came to the conclusion that in the upright position the pylorus was usually a pelvic organ. When we came to take pictures of the neurasthenic patient, we at once found that the stomach was in the same position but flaccid, baggy, and flattened at the pylorus, showing marked lack of tone of the stomach wall; and we soon discovered that the most of these people without tone had been operated upon for removal of the appendix, but that they still had their right-sided pain and tenderness. As their appendices had been removed and the upper point of tenderness did not correspond with the position of the gall-bladder, we were at a loss to explain their attacks of colicky pains in the right abdomen. Later several of these people came to us from other

medical men with the diagnosis of chronic appendicitis, desiring operation. Several already observed were our own cases where removal of the appendix had failed to effect a cure. They were usually of the neurasthenic type so well described by Reynolds before this society one year ago. Many of them had discovered for themselves that their discomfort, which came about one hour after eating, could be relieved by lying down, which we believe is a valuable point in making a differential diagnosis.

When we found that young children had these same atonic stomachs without other prolapsed viscera, we commenced to understand the course of events at least in a certain class of early neurasthenias.

The digestive function of the stomach is, we believe, chiefly mechanical rather than chemical; a storehouse for food and an organ for churning and grinding of the food, so that it may be ready for the really important intestinal chemical digestive processes. Now as we look at a dilated prolapsed stomach, and realize that when the patient is in an upright position the stomach, after it has prepared the food, must lift it over the duodenal hill at least some five inches in height before any real digestion can take place, we realize that its muscular power must be up to normal, or the patient will commence to be uncomfortable and will as a result starve himself and so will soon lose weight.

This, in truth, is just what happens whenever the child or grown person loses flesh or strength from any cause and becomes weak and debilitated. Under these circumstances the stomach wall relaxes, the pyloric end sags, and the food cannot be lifted into the duodenum. Fermentation commences and the digestion becomes painful. Distinct attacks of pain are frequent; the greatest distress, as we have said, is usually referred to the right abdomen, at first one or two hours after eating, later the discomfort becomes constant, spreading all over the abdomen, sometimes with nausea, occasionally with vomiting. This distress almost never comes at night, and is often relieved by eating, more frequently by lying down, especially if the patient lies on the right side.

When the digestion becomes painful the patient starves himself, or more often herself, and so aggravates and intensifies the condition, rapidly drifting into the condition which we speak of as true neurasthenia. Stiller thinks that these conditions are congenital. The fact that these people can be so easily cured proves to us that they are not congenital. They undoubtedly inherit a weak constitution or a favorable soil for the growth of all these complex nervous symptoms. Whether congenital or acquired, we think we have seen the earliest signs or the first stages of neurasthenia in this stomach atony in young children who, by the way, react much more promptly than adults to intelligent treatment; so that for a time at least we have been able to put off the evil day. Goldthwait appears to think that some of these cases are due to postural errors, whereas we believe that the faulty attitude and carriage are late symptoms of the general relaxation due to starvation.

In regard to the etiology of this condition, we believe that gastric atony is closely allied to acute dilatation. Payer has recently described the milder forms of acute dilatation, which often pass unrecognized. We believe that after illness, shock, grief, etc., occasionally a mild acute paresis of the stomach will occur, which if unrecognized and untreated passes on into a chronic type, which we see in these typical neurasthenic atonic stomachs.

*Treatment.*—The observations of Makovic and Perussia (*Medical Klinik*, 1910) showed that position has a most marked influence in accelerating or retarding the passage of food from the stomach, making an increase of almost three hours in the emptying of the stomach when the patient was lying on the left side as against the same position on the right side. Consequently in dealing with these people the first thing to do is to describe to the patient the condition as shown in the picture and tell him the results that he may hope for if he will help to empty his own stomach by lying down on the right side when he has pain.

The internal medical man and the neurologist have for years been able to make most satisfactory cures of these

patients. They have known that the rest cure, with a special nurse and several weeks' stay in the hospital, would cure these patients, but it seems to us that they have not quite understood why they got such good results. Later when these patients had recovered, many of them relapsed because they were not properly instructed as to their future behavior.

But what is to be done for the working woman, for the shop-girl, who cannot afford all of these luxuries? Must she be abandoned to her fate? We believe that we have very materially helped a considerable number of these people without a formal rest cure and without medicine, and usually without an operation. If an operation has to be performed for some absolute physical or mechanical condition which interferes with the nutrition of the patient, she should be kept a much longer time in bed, and during her convalescence should be started on the line of forced fat feeding. After an operation it is always a mistake to let these people go home too early.

In regard to operations upon the stomach itself, if we are correct in our interpretations of these stomach plates and if the symptoms in these cases are due to loss of normal muscular power, as we believe them to be, then it would seem as though gastro-enterostomy, gastroplication, and gastro-suspension would accomplish little if any good, because operations upon the stomach itself will not increase the muscular strength of this organ, and the few days of operative starving will take away a little more flesh and strength and make the general condition worse.

We have tried gastroplication of the stomach by putting two or three rows of silk suture across its long axis, raising temporarily the site of the pylorus. A second picture taken a few weeks later showed the stomach to be of much the same size and practically in the same position as before the operation. These patients were a little better, but we believed that the improvement was due to the rest cure and the forced feeding, rather than a result of the operation. We have seen several of these stomachs where gastro-enterostomies have been done with no benefit. Some of them were our

own failures, done at a time when gastric ulcers were supposed to be multiple and when calloused ulcer was supposed to be the exception, not the rule. If gastro-enterostomy is ever justifiable in these cases, Bach is no doubt correct when he claims that the ordinary short loop operation only kinks the intestinal opening, and that if any operation is done it should be the Roux enterostomy *en Y*. At present, however, we believe that these people do not do well after any operation, that they are medical and not surgical in character.

In regard to gastrosuspension, we have seen some which did not hold, as for instance Case II reported in this paper. Eve, Rovesing, and Beyea all regard this neurotic condition, which we have been discussing, as a consequence of the gastropptosis or better pyloroptosis, but they all express the opinion that gastropexy should be done in these cases and that this operation will cure the disease. Our observation, in this as in other fixation operations, is, that when we suture living tissue, and especially muscular organs like the large intestine or the stomach, any suture which is strong enough to hold is almost certain to cut through in a few days, letting the organ soon fall back into its former position. Recently we tried to fasten a dilated obstructed cæcum into the abdominal wound for the purpose of making a fecal fistula; the stitches had all cut out the next day, and the intestine had drawn back into the abdominal cavity. Gerster, in the last "Progressive Medicine," believes that the American surgeon is not ready to accept gastropexy as a cure for pyloroptosis. On the other hand, without any operation we have seen most marked improvement in many of these patients. These people are easily affected by a faith cure, but imagination will not make them put on flesh. We subjoin two cases in illustration of these conclusions.

CASE I.—Mrs. K. was curetted for dysmenorrhœa ten years ago. Eight years ago she still had dysmenorrhœa, right sided, and backache. She had a retroverted uterus and was markedly tender over her appendix; at that time I removed the appendix, which contained four good-sized enteroliths, and she was better for a time, although her right-sided dysmenorrhœa continued as

before. She was soon after married, and in February, 1904, her first baby was born. This relieved her of her dysmenorrhœa, but she continued to have such marked gastric trouble, with gas and vomiting attacks, that four years ago she had a gastro-enterostomy. This so increased her discomfort, that two years ago Dr. M. unfastened the gastro-enterostomy and suspended the stomach with two linen sutures, fastening the gastrocolic omentum to the suspensory ligament of the liver. When she came to us four months ago she was a nervous wreck, unable to do her work, almost insane from neurasthenia. The X-ray showed the typical prolapsed atonic stomach, which could not empty itself. Forced fat feeding and rest after meals changed this picture, so that in four weeks she gained eight pounds and said, "I am well, I have not felt like this for years." Her stomach was practically in the same location that it was before her cure.

CASE II.—Mrs. G., aged forty-six, mother of three children; youngest child seventeen years of age. She was a tall, angular, thin, anæmic neurasthenic. She was 5 ft. 9 in. in height, weighed 118 lbs. For many years she had suffered from frequent attacks of vomiting of large quantities of fluid, mixed with blood on two occasions. Her stomach was very low and markedly atonic, as shown in Fig. 3. After two months very indifferent postural treatment by herself, she gained 16 lbs. and regained her tone, as shown in Fig. 4.

In conclusion we believe:

First, position of the stomach is not important, that the pylorus is practically a pelvic organ.

Second, the principal function of the stomach is mechanical.

Third, the beginning or first symptom of the so-called neurasthenia is due to gastric atony.

Fourth, postural drainage and fat feeding, temporarily at least, cures these patients.

Fifth, from our present experience, we believe that operations on the atonic stomach to change its position and help its drainage have still to be proven advisable, because no operation will take away the muscular atony but will rather aggravate it.



# ULCER OF THE STOMACH AND DUODENUM WITH SPECIAL REFERENCE TO THE END RESULTS.\*

BY WILLIAM J. MAYO,

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ON January 17, 1911, we (C. H. and W. J. Mayo) completed a series of 1000 operations upon the stomach and duodenum for indurated ulcer. The total number of cases operated for ulcer was considerably more than 1000, but the only ones considered in this study were those in which an actual demonstrable ulcer existed, that is, one that could be seen and felt in the stomach or duodenal wall. All of the so-called clinical, medical, and mucous ulcers have been excluded because of insufficient evidence of the actual presence of an ulcer.

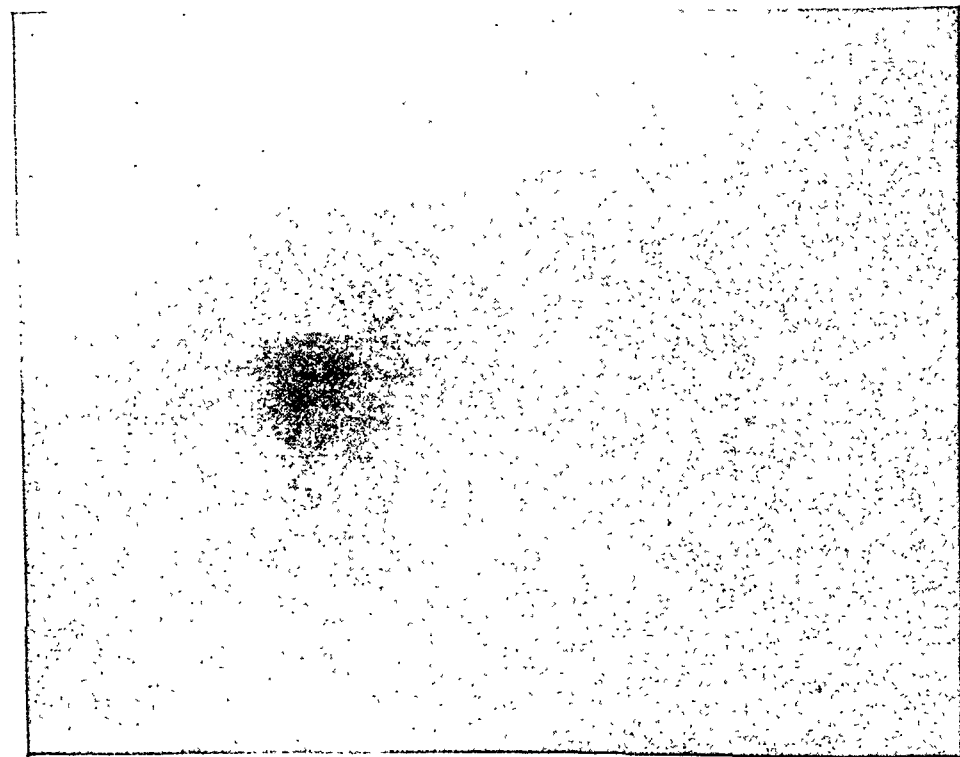
The question as regards the existence of a group of ulcers in the stomach and duodenum, chronic in character, which are non-indurated and confined to the mucous membrane, must still be held *subjudice*. That acute mucous ulcers exist as a result of toxic poisons cannot be doubted, but all the evidence which we have at hand goes to show that acute ulcers heal if the patient does not succumb meanwhile to perforation or hemorrhage.

These acute ulcers and mucous erosions are almost always multiple and are caused by a variety of gastrototoxic substances. Toxic erosion of the gastric mucosa is the usual cause of the gastric hemorrhages which accompany cirrhosis of the liver, splenic anæmia, and certain disordered blood states.

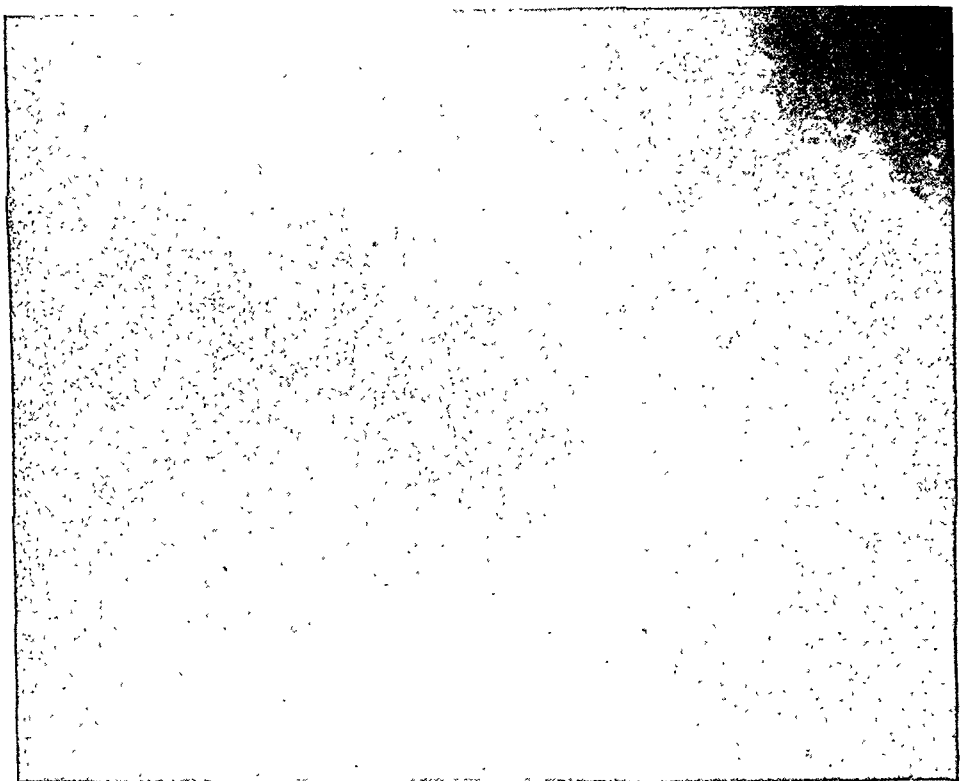
Acute mucous ulcers apparently do not give rise to the chronic indurated ulcers; at least in going over the histories of the indurated ulcers which we have operated, few, if any,

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Case II.



Case II. Taken four months after Fig. 3. Stomach regaining tone.

fied as gastric, and in all probability many of them were duodenal in origin.

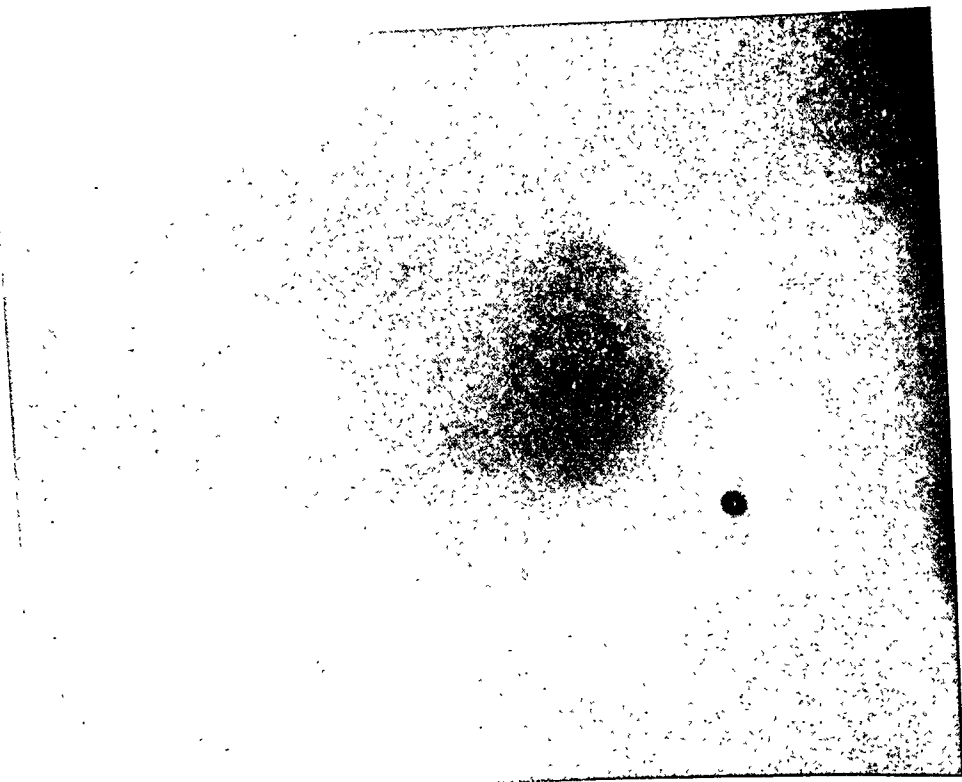
Previous to June 1, 1906, 379 cases of gastric and duodenal ulcer were operated. Of these, 227 (59 per cent.) were classified as gastric, and 152 (41 per cent.) as duodenal; *all of the ulcers around the pylorus being classified as gastric.*

From June 1, 1906, to January 17, 1911, 621 cases of gastric and duodenal ulcer were operated, of which 201 (32.5 per cent.) were gastric, 401 (64.5 per cent.) duodenal, and 19 (3 per cent.) were shown to have an ulcer of each viscus. That at least two out of three cases of ulcer will be found to have their origin in the duodenum rather than the stomach is a conservative estimate.

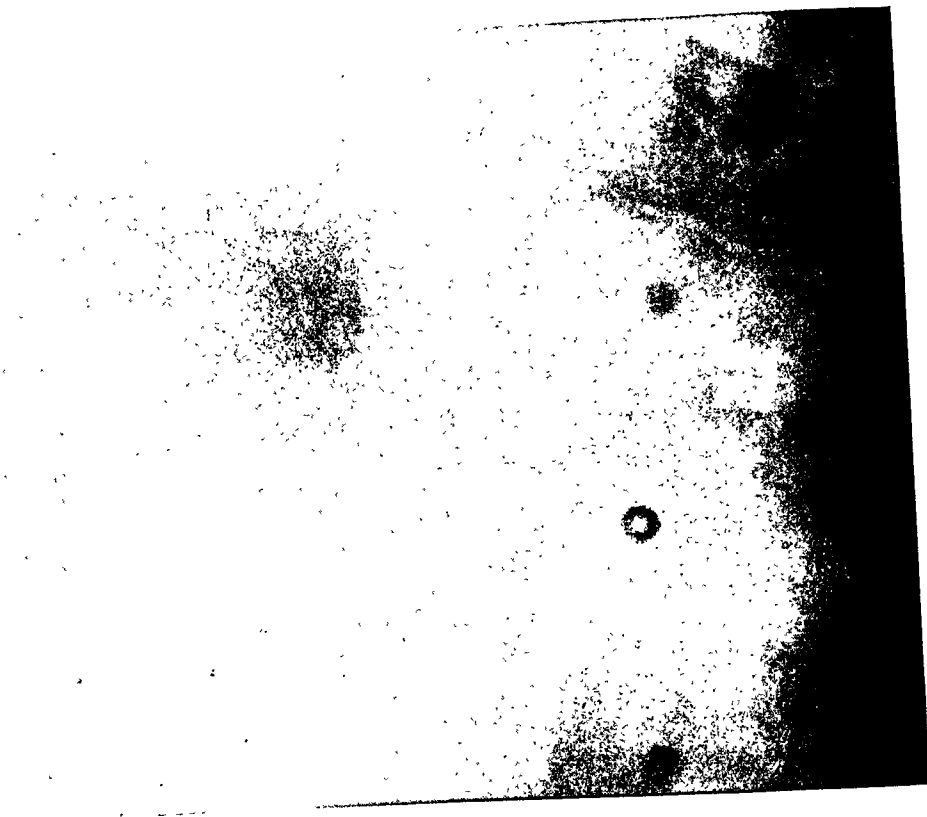
That benign ulcer was more common in women than in men was another almost universally accepted statement. Of our 1000 cases, 255 were women and 745 (practically three out of four) were men.

Another erroneous opinion tenaciously supported concerned the number of ulcers present in the involved organ, it being alleged that multiple ulcers were the rule. While this is quite true of acute toxic ulcers, it is certainly not true of the chronic indurated ulcer, more than 95 per cent. of which are single.

A study of the symptomatology of gastric and duodenal ulcer demonstrates that the greater number are situated within two inches of the pylorus, and that all of these ulcers give a fairly definite clinical picture; pain coming on from one to three hours after meals, often in the night, and relieved by taking food, alkalies, etc. In the early stages hyperacidity is a fairly constant symptom, although, when there is obstruction or the disease exists in individuals in the later decades of life, the acidity may be normal or below normal. Hypersecretion, giving rise to sour belching and eructations of acid fluids, is a prominent feature and one that is more persistent than hyperacidity. Hemorrhage, both obvious and occult, is less important in the diagnosis than we were led to believe,



Mrs. M. Had been operated on for chronic appendicitis. Figure shows gastropptosis and gastric atony.



Mrs. M. Same patient as shown in Fig. 7. Taken after gastroplication and prolonged rest cure. Shows stomach has regained its tone.

dition on the food which circumstances permit him to obtain, and his chronic disability interferes with his vocation.

A study of the end results in this series of cases has been made for the purpose of showing what surgery has actually accomplished in this field. We have made a classification as follows:

First, gastric ulcers: (*a*) ulcers with obstruction, pyloric or hour-glass; (*b*) ulcers without obstruction, usually ulcers of the body of the stomach.

Second, ulcers of the duodenum treated by (*a*) gastrojejunostomy with or without infolding the ulcer; (*b*) ulcers excised with or without pyloroplasty or the gastroduodenostomy of Finney.

The operative mortality in our series of 1000, including all classes of cases and types of operation, was 2.4 per cent.; 379 of these patients were operated upon previous to June 1, 1906, before the operative technic had been well worked out; therefore imperfections in methods were responsible for some failures to cure and some deaths. However, it may be stated in a general way that in all the earlier cases in which there was obstruction, the results were favorable. Fortunately, but few cases were operated upon during the early period unless obstruction was a marked symptom; the average percentage of recoveries was therefore high. The proposition still holds good, that ulcers which cause obstruction, either potential or actual, present a high percentage of cures.

In 19 cases of duodenal ulcer, the ulcers were excised with or without pyloroplasty or the gastroduodenostomy of Finney. The cases in which excision, with or without pyloroplasty, was done were not so satisfactory as those treated by gastrojejunostomy, and two out of this small group of cases required secondary gastrojejunostomy before a cure was accomplished. The explanation of this appears to lie in the fact that after plastic operations about the pylorus crippling adhesions are prone to follow, and, while an adequate opening



learn why these patients had not recovered, as a rule we found the site of the former operation fixed by adhesions. This has been particularly true following excision of ulcers in the posterior wall of the stomach when adhesions to the pancreas were found at the time of the primary operation.

In some cases when a gastric ulcer was difficult of access and not large, instead of excising, we have applied sutures in such a manner as to cut out the ulcer base, and have then covered the part with a second row of musculo-peritoneal sutures. This procedure is simpler than excision, but it is applicable only to those ulcers having but a moderate amount of induration and in which excision would be difficult and dangerous.

In experimental studies which Maury made in the normal dog, it was shown that a pentagonal compression stitch can be applied to any hollow viscus in such manner as to destroy the included part with certainty.

In a few of the cases very extensive ulceration of the body of the stomach precluded the employment of any operation upon the stomach, and jejunostomy for jejunal feeding with complete rest of the stomach for some weeks has been necessary. Clairmont has advocated this plan strongly in such cases, and in the few instances we have practised it the results were good.

From the above data it is very evident that operations for duodenal ulcers present a higher average of cures than operations for gastric ulcers. Gastrojejunostomy, with or without infolding the ulcer, not only affords great relief to the patient with duodenal ulcer but a permanent cure in a remarkably high percentage of cases.

These statistics indicate: First, that the treatment of all duodenal and all obstructing ulcers of the pyloric end of the stomach by gastrojejunostomy and excision, or infolding the ulcer, is satisfactory and gives 98 per cent. of cures or great improvement. Second, 85 per cent. of ulcers of the body of the stomach will either be cured or greatly relieved

could be traced to this acute condition. Nevertheless, I suspect that mucous ulcers, fissures, or erosions of a chronic character may exist and show no evidence of their existence on the exterior of the stomach, but such conditions must be rare. On several occasions we have examined the stomach and duodenum through an abdominal incision without finding any evidence of ulcer, and the continued symptoms for some months led to a second exploration when an ulcer was discovered. Either the ulcer had been overlooked at the primary operation or it had been confined to the mucous membrane, and the musculoperitoneal coats were involved later. This is a question which must be cleared up by further investigation; but until we can secure stronger clinical evidence than is now at hand, an ulcer must be demonstrated by sight and touch before its existence can be regarded as proven.

In a few instances we have incised the wall of the stomach and searched the gastric mucosa for mucous ulcer, but the results were rather uncertain. The gastric mucosa bleeds easily on manipulation, and the question arises: Was the lesion which was found in the mucous membrane caused by the instrumentation or was it present before the examination?

The proximal duodenum above the common duct is embryologically, functionally, and pathologically closely related to the stomach, although morphologically it has the appearance of the small intestine. Its mucous membrane is thin and granular, without *valvulae conniventes*, and it does not have any great degree of muscular action. I have seen muscular contraction in the stomach and practically all parts of the intestinal canal, but I have never seen a peristaltic wave in the first four inches of the duodenum.

That benign ulcer was a disease of the stomach and rarely found in the duodenum was a dictum accepted until within recent years. Of the 1000 cases in our series, 428 were classified as gastric and 572 as duodenal. This is not a fair relative percentage, because the earlier cases in which an ulcer was found in the vicinity of the pylorus were classi-



# OBSTRUCTION OF THE ILEUM BY A LARGE GALL-STONE; ENTEROSTOMY; SUBSEQUENT CHOLECYSTECTOMY AND SUTURE OF DUODENUM.\*

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THE following case is reported on account of the interest the surgical problem presented, namely, the obstruction of the lower ileum by a large gall-stone which had reached the intestine by an anastomosis between the gall-bladder and the duodenum, and the fact that at the time of the operation another large gall-stone was felt in the gall-bladder. The patient seemed too ill to make it safe to prolong the operation for the removal of these stones in the gall-bladder and we waited three weeks, fearing all the time that this second large stone might slip into the intestine and cause a recurrence of the obstructive symptoms. At the end of the three weeks the gall-bladder was successfully separated from the duodenum and removed, and the large opening in the duodenum closed by transverse sutures. She made an uninterrupted recovery.

The patient, Mrs. L., a thin, delicate woman, aged forty-five years, had suffered four years ago from an attack of abdominal pain and vomiting without jaundice. The illness was severe enough to keep her in bed for two months. Previous to this, she had suffered from indefinite pains in her right side and more or less bloating when tired. Ever since the attack four years ago she had remained rather thin and weak. Again, two years ago, she had an attack of pain in the right hypochondrium which would begin under the right ribs and work across the abdomen, with much gas and pressure. She was so tender that she could not bear to be touched. Constipation was very severe. We had, therefore, the history of two severe attacks of pain upon which the diagnosis of gall-stones might very well

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and so far as hæmatemesis is concerned, it can only be accepted as indicative of chronic ulcer when it is preceded and followed by other symptoms of ulcer.

The most important diagnostic sign is food retention, not necessarily the gross obstruction, but the finer degrees of obstruction, causing small particles of food to be found in the stomach eight, ten, and twelve hours after meals. Other things being equal, food retention is an indication for surgical interference.

The patient with ulcer of the body of the stomach often gives a confused history—pain, coming on within an hour after eating and often passing to the left in the region of the body of the pancreas. When the symptoms are clear but not orderly in arrangement, the location of the ulcer will often be responsible for the disorderly symptoms.

A differential diagnosis between duodenal and gastric ulcer can usually be made without difficulty but it is not essential. It has been generally observed that the location of the lesion is usually duodenal if there is a long interval between food and pain, and especially if the point of pain is a little to the right of the median line as well as in the epigastrium. A very common source of error in differential diagnosis lies in the frequent association of ulcer with gall-stones, appendicitis, etc. We have frequently been able to establish these three independent conditions before operation.

Every operation upon the stomach should be preceded by a careful examination of all the organs which might harbor diseases having similar symptomatology; a differential surgical diagnosis at the time of operation is quite as essential as a differential medical diagnosis before operation.

The indications for the surgical relief of chronic ulcers of the stomach and duodenum are both positive and relative: positive if obstruction, repeated hemorrhages, and severe pain exist, or, if on account of disturbed digestion, the patient is insufficiently nourished; relative, when for any or all of these reasons the patient is unable to maintain good physical con-

then ecchymosis on the intestine. Part of it was very dark in color. The incision in the intestine was closed with double Lembert sutures. The gall-bladder was examined and found to be in anastomosis with the duodenum. The gall-bladder was felt to contain a large stone and one or two others. Although it was felt that these stones might drop into the duodenum at any time, progress into the ileum, and cause obstruction, it was decided best to take the chances on account of the patient's poor condition, and not attempt to remove it at present. It was felt that the gall-bladder had so relaxed by the expulsion of this first large stone that probably it would not contract sufficiently to expel the other into the duodenum. The patient did well except for a stitch abscess in the abdominal wound. During the next three weeks there was tenderness over the gall-bladder and muscular spasm. She suffered somewhat from pain.

On March 28 an upper right rectus incision was made and the gall-bladder found buried in adhesions. On dissecting it out it was found to contain two stones, one of them quite large, about half the size of the one removed at the previous operation. On opening the gall-bladder, the larger stone was found to lie against a very large hole leading into the duodenum, which would easily take two of my fingers. There was no bile in the gall-bladder, which was firmly contracted about these two large stones. With considerable difficulty it was dissected free from the duodenum and removed. The adhesions, both old and new, made this a difficult proceeding, especially on the under side. The opening in the duodenum was then sutured transversely with continuous Connell sutures of catgut reinforced by interrupted Lembert linen sutures. The patient bore the proceeding well and has made an excellent recovery, and is now in good condition.

The very large size of these gall-stones is interesting. They must have remained there a long time, it seems to me, before they caused any symptoms at all.

The perforation of the gall-bladder into the duodenum, I think, must have occurred during the second attack, in 1909, as the account of this illness reads like a severe attack of local peritonitis. This large stone probably had lain against that opening ever since, which had been gradually enlarged as the contraction of the gall-bladder forced the stone against it until,

can be made, the progress of food is apt to be delayed and painful. The gastroduodenostomy of Finney gave much better results than those following pyloroplasty. In fact the late results in all the cases in which we have employed the Finney operation were excellent.

In studying the histories of the gastric ulcers, we found that practically all which were situated close to the pylorus and accompanied by obstruction were relieved by gastrojejunostomy whether or not the ulcer was excised. However, whenever it was possible to do so, we excised the ulcer because of the liability to cancerous degeneration. For obstruction of the pyloric end of the stomach, and for ulcers of the duodenum, gastrojejunostomy appears to furnish practically an equal percentage of cures.

Gastrogastrostomy and gastrojejunostomy as a method of treatment for obstruction due to hour-glass stomach have given good results. With the view that the scar tissue found in the hour-glass stomach was a cancer menace, whenever possible we have made a transverse resection of the hour-glass contraction, including the scar tissue, with circular end-to-end union. While the results have been satisfactory, I believe that, taken all in all, these patients do not experience the complete relief which occurs when gastrojejunostomy is a part of the procedure.

Ulcers of the body of the stomach without obstruction, especially those deep excavations adherent to the pancreas, etc., have given the least satisfactory results following excision. In some of these cases the symptoms redeveloped to a greater or less degree, and a secondary gastrojejunostomy was necessary for relief. A *combination of gastrojejunostomy and excision* gave much better results than excision alone. It is notable that, following excision, there was more or less failure to cure when there was ample lumen in the stomach distal to the part excised, and even with excision and gastrojejunostomy the results have not equalled those obtained in pyloric stenosis and duodenal ulcers. When we explored later to

# ON CHRONIC COLITIS AND PERICOLITIS.\*

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BACTERIAL infection of the peritoneum, either by direct surface contact, or from within the visceral lumina by exosmosis through their walls, leads to denudation of its endothelial covering, which may result in adhesion of adjacent surfaces. The solidity and density of adhesion seem to depend as much upon the duration as upon the intensity of the infective process. Chronic ulceration, such as for instance that caused by a foreign body in the appendix, may produce the densest and most massive deposit of newly formed connective tissue. Naturally, the deposit is most dense in the immediate vicinity of the inflammatory focus, diminishing in proportion to distance. In the case of adhesions due to bacterial infection, the principle "*cessante causa, cessat effectus*" obtains in the most eminent way. Experience on the operating table and in the autopsy room has furnished abundant proof of the truth of this fact; for, extensive, dense adhesions, which had been demonstrated at a previous operation, were found entirely absent at a subsequent operation or autopsy.

The modus of absorption and disappearance of adhesions is, strictly speaking, a physiological process, parallel to the embryonic processes of the formation of all saccular cavities lined with endothelium, such as the joints, the bursæ, the sheaths of the tendons, the pericardium, pleura, and peritoneum. Its factors are absorption, dehiscence, and locomotion, this last factor mainly derived from the friction of adjacent tissue planes.

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\* Read before the American Surgical Association, June 21, 1911.

by excision, or devitalizing suture compression with gastro-jejunostomy. In addition, closure of the pylorus may be practised with benefit. The remaining 15 per cent. will be more or less benefited and, so far as we have observed, none have been made worse by operation. The mortality of the surgical treatment of chronic gastric and duodenal ulcer is well under 2 per cent.

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NOTE.—I am indebted to Dr. Eusterman for his careful compilation of the statistics, and for ascertaining the present condition of the patients.

minute vessels is seen extending transversely to the gut. This vascular system holds no close relation with that of the surface of the gut, for stripping off causes little if any hemorrhage. Should a portion of the membrane, but especially one containing a restricting band, be divided, a lozenge-shaped hiatus is immediately formed, and the correspondingly restricted area of the gut, being freed, unfolds. Transverse division of the entire "veil" consequently permits complete unfolding of the gut. Whether divided or excised, these membranes invariably reform if their cause, the colitis, persists. Their most massive development takes place around the physiological points of relative narrowing of the gut (such as the cæcum, the hepatic, sigmoid, and especially the splenic flexures). Habitual constipation arrests the progress of the intestinal contents, and should ulcerative processes supervene at these points, the membranous formation may become modified by more or less massive deposits of cicatricial tissue, representing close, true adhesions.

As attested by all authors beginning with Virchow, this process has a predilection for the vicinity of the splenic flexure, where, as Cannon has demonstrated in the cat and Holzkecht and Bloch in the human being, several factors combine to cause an arrest of fecal transportation. First of all, the large gut is firmly attached here to the under surface of the diaphragm by the short phrenocolic ligament. This, the highest attachment of the colon, is the apex of a sharp bend, where portions of the transverse and descending colon for a distance of even six inches are normally found lying parallel in close contact with each other. At the bend itself a spur is invariably present. Its action as a valve depends upon the degree of its development which is variable (Roith). According to Cannon, the purpose of this arrangement is to prevent the rapid entrance of fecal matter from the upper portions of the colon into the sigmoid. The function of the former is absorptive, of the latter, eliminative. Hence we find that ordinarily the cæcum, ascending and transverse colon are distended with fæces and gas, while the sigmoid is

be made. At the time I saw her, in consultation with Drs. Dewis and Cunningham, she had been attacked, while visiting a friend, with pain in the right upper quadrant. The pain was not so severe that she felt obliged to go home, although she did not eat anything all day. Toward evening, her husband took her home, the pain then being very severe. She vomited that night and all the next day. The pain became worse and gradually moved from the right to the left side of the abdomen. She was unable to have a movement of the bowels with an enema. The third day she vomited less, and the day I saw her, which was the fourth day, about six in the evening, she had not vomited at all, but was nauseated and had had no movement of the bowels.

Examination showed a very frail, delicate woman, rather anæmic, abdominal walls thin, abdomen markedly distended, and distinct visible peristalsis. In the right iliac region a very tense coil could be felt. There was very little tenderness over the abdomen and no muscular spasm. I saw her at 6 P.M., when she was removed to the Bay State Hospital, and I operated that same evening. Rectal examination showed a rectum ballooned and empty. The tongue was dry, and she looked quite ill. The diagnosis was intestinal obstruction probably by a band, although the gradual onset of the pain did not seem exactly consistent with this diagnosis. It seems to me that a careful study of the previous history combined with the gradual onset of the pain might have suggested intestinal obstruction by a gallstone. A very interesting part of the history to me was that the pain began in the upper right quadrant and then went across to the left, probably as this large stone travelled across the duodenum and through the upper coils of the ileum in the left side of the abdominal cavity. At the operation, which was performed at 8 P.M. the fourth day, I found the upper three-fourths of the small intestine very much dilated and reddened. There was a large amount of free fluid in the peritoneal cavity. In the lower quarter of the small intestine there was a very large stone entirely blocking the bowel, which below the stone was much contracted and ribbon-like. The stone was firmly grasped by the intestinal muscle, and could with difficulty be pushed back. The intestine was incised and the stone removed. All the small intestine above the stone was then strung on a three-foot-long Monks's tube and thus easily emptied of its contents. There was



shadowed the underlying colitis, which consequently escaped attention. Hence it is not rare that the successful removal of a damaged appendix is not followed by complete and lasting cure; and more or less prolonged periods of temporary relief can only be obtained by means of careful and continuous regulation of the intestinal function by diet, enemata, and laxatives.

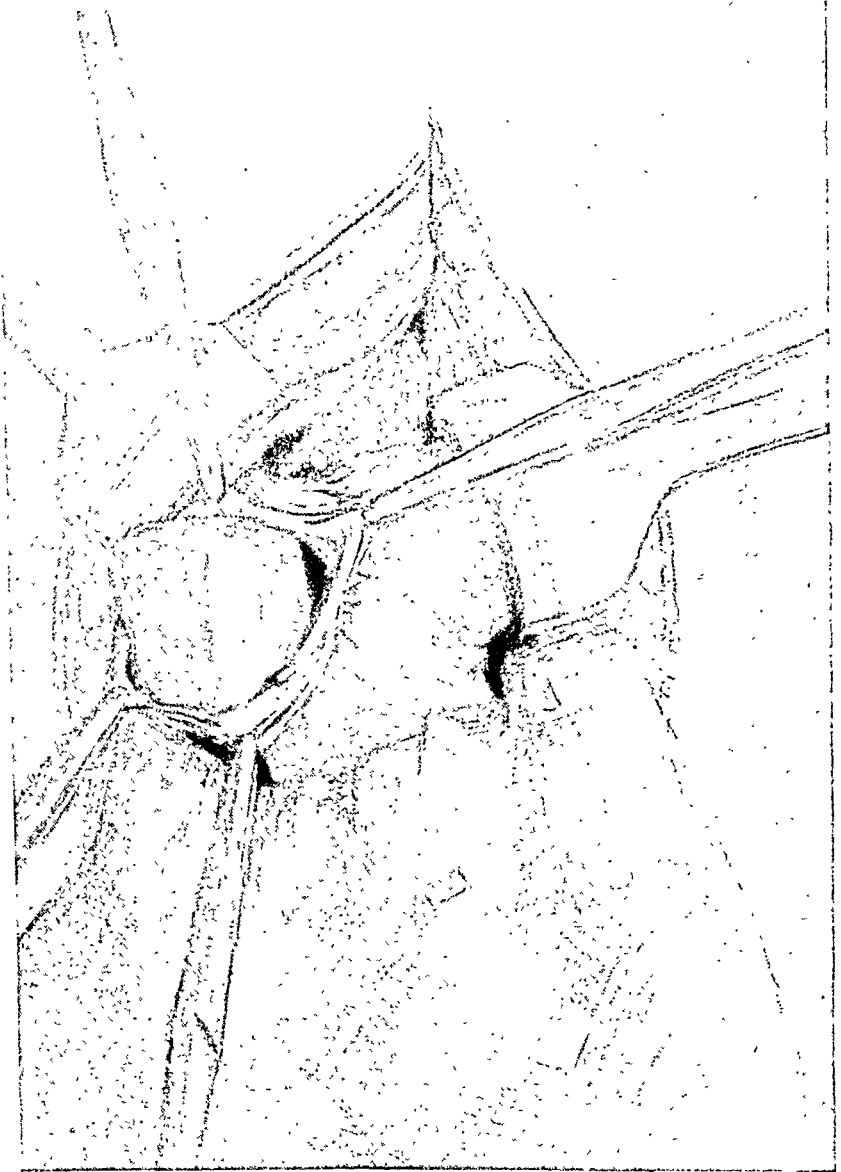
The symptomatic pre-eminence of the cæcum and ascending colon is based on certain anatomical peculiarities of this part of the large intestine. First, it normally represents the widest and most distensible portion. This distensibility is the direct outcome of the fact that here the muscular layer is thinner and weaker than in any other part of the large intestine. Furthermore, being the chief seat of bacterial proliferation, it is also the chief seat of catarrhal disturbances and of gaseous production. The final outcome of these factors is habitual distention and atony ("typhlatony").

Wilms<sup>3</sup> found in a considerable number of cases, that symptoms of chronic appendicitis were simulated by cæcal processes, which, in his opinion, were due to great laxity of the attachments of the caput coli. To this abnormal mobility he attributed an impeding effect upon cæcal evacuation, which in its turn was responsible for recurrent attacks of cæcal colic. This symptom complex consisted in the periodic appearance of a palpable, painful tumor in the right iliac fossa, with simultaneous recurrence, in the habitually constipated patients, of violent attacks of colic centred about the cæcum, the trouble being relieved by one or more copious evacuations of fæces and gas.

NOTE 1.—In a recent communication of great interest (Schmerzempfindungen innerhalb der Bauchhöhle, etc., *Med. Klin.*, Jan., 1911) dealing with the significance of pain in the abdominal cavity, Wilms refers to the regular presence of pseudoperitoneal veil-like "adhesions" about the cæcum mobile, characterizing pains from these as "Adnäsions beschwerden." This is, however, only a seeming paradox.

The correctness of Wilms's views seems to be supported by the evidence of his experience with colopexy done by him

FIG. 3.



Showing removal of stones from gall-bladder in anastomosis with duodenum.

upon here. It may suffice to say that in many cases where there is no hereditary taint, an acquired neurasthenia of intestinal origin may be improved, if not cured, by proper measures.

Though the common forms of chronic colitis in most instances lead only to the formation of the pannus-like pericolic membranes above described, in rare instances they may cause the development of intramural abscess of the intestinal wall, with or without perforation. Bittorf<sup>6</sup> quotes Lejars (*Sem. Med.*, 1907, No. 52) and Donaldson (*Brit. Med. Jour.*, 1907), who have encountered perisigmoidal abscesses on the operating table. He also mentions similar experiences of himself (*loc. cit.*, p. 163) and of Bäumlér (*Arch. f. klin. Med.*, vol. lxxiii, 1902, p. 96), one of whom found a non-perforated intramural abscess of the cæcum near the ileocolic valve, the other a similar abscess in the wall of the ascending colon. Both patients died of streptococcic peritonitis. In both of these cases the appendix was healthy. Bittorf (*loc. cit.*, p. 162) mentions besides these, the case of Matthes, who, operating for presumed appendicitis, found the appendix normal, the sigmoid, however, intensely congested and thickly coated with a deposit of fibrin.

The peculiar parallelism of transverse and descending colon, near the splenic flexure, and the sharp angle and spur formation there, constitute favorable conditions for producing and maintaining constipation. The resulting chronic colitis may lead to production of copious pseudoperitoneal membranes. Where fecal retention has led to ulcerative processes of the mucosa, extensive firm adhesions between the parallel segments of the intestine may result.\* This condition is so typical that the term "Doppelflintenstenose"—double barrel stenosis—has been suggested and accepted.

Various examples of the disorder are cited in American,†

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\* Analogous conditions have been observed at the hepatic flexure.

† The most noteworthy American publication on this subject to date (May, 1911) is by Jabez N. Jackson, "Membranous Pericolitis," *Surgery, Gynecology, and Obstetrics*, Sept., 1909, p. 278.



the gut upon the edge of such a strand may occasionally cause serious trouble.

2. An eminently predisposing factor of chronic colitis is an undue developmental accentuation of the physiological apparatus serving to retard fecal transportation. This refers mainly to the arrangement of the splenic, and, in a lesser degree, of the hepatic and sigmoid flexures. Congenital or acquired laxity of attachment, and congenital or acquired redundancy of diameter, or of length, of certain portions of the large intestine, may both be strongly predisposing and seriously aggravating factors in the development and course of the disease.

3. Prevention has a wide field of usefulness, especially here in America, where chronic colitis is almost endemic. A reasonable restriction of animal food will control putrefactive processes; a generous and daily use of fresh vegetable matter in the shape of well-cooked and attractively seasoned dishes will supply bulk and friction needed to induce normal and adequate peristalsis. The practice of what may be called "physiological intestinal discipline" should be inculcated from infancy, and should become as much a part of personal hygiene as are ablutions and baths.

NOTE 3.—The prolonged use of daily small doses (1 teaspoonful) of castor oil, taken before breakfast, combined with a diet suitably adapted to each case will cure, or at least control, many cases of early and not too aggravated chronic colitis. Buttermilk is an admirable adjuvant.

4. The graver aspects of the malady usually demand surgical intervention; but here, too, good results follow only, if dietary and general hygienic measures are subsequently instituted and consistently practised.

#### HISTORIES

To illustrate the condition, I present herewith extracts from the histories of five typical cases observed in my wards between November 10, 1910, and April 12, 1911.

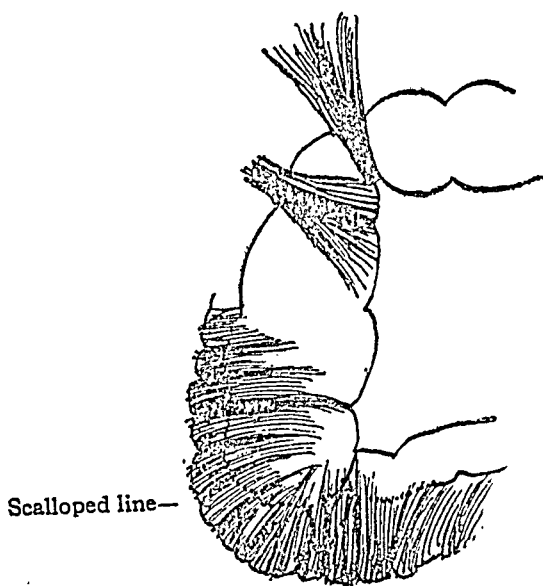
CASE I (Surg. No. 118784).—Joseph W., aged thirty-five; tailor; Russian. Admitted Nov. 10, 1910.

four days before I saw her, it was squeezed through and went on its way to obstruction.

The chief interest in this case, it seems to me, lies in the question of diagnosis. The commonest cause of obstruction with which we have to deal is obstruction by bands. These bands usually occur in the pelvis, either from disease of the female pelvic organs or from appendicitis, and involve the small intestine, causing strangulation and kinks. Peritonitis, due to gall-bladder disease, rarely causes intestinal obstruction because the gall-bladder is hidden behind the large intestine, between it and the liver, and can with difficulty become tied to the mobile small intestine. Therefore, intestinal obstruction by bands ought to be, and is, rare after a definite history of disease of the gall-bladder. It is also true that the onset of intestinal obstruction by bands is more acute and the progress of the disease more rapid than in the case of obstruction by an enterolith. In the case here reported, the pain at onset was not severe enough to keep the patient from continuing at her work of sewing for eight or ten hours. The gradual change of location of the pain was suggestive of the change of position of the enterolith, and the time when the symptoms became severe enough to lead to a surgeon being called was four days later. It would therefore seem possible in another case of this sort to make a correct diagnosis of obstruction by enterolith instead of the erroneous diagnosis of obstruction by a band, based (*a*) on the previous history of gall-bladder disease suggesting enterolith; (*b*) on the gradual, instead of sudden, onset and slow progress of the symptoms.

portion of this membrane was divided by a transverse incision, whereupon the gases in the cæcum immediately escaped into the transverse colon. The site of the incision assumed the shape of a lozenge, the longer sides of which (lying crosswise to the longitudinal axis of the gut) were united by a few catgut stitches. A similar membrane of lesser size, involving the ascending colon, was likewise dealt with. The caput coli and appendix were thickly enveloped in an extensive arrangement of pseudomembrane from which, the thickened and congested appendix, which was bent upon itself, was easily shelled out,

FIG. 1.\*



Showing pseudomembranous fibres and bands resulting from chronic colitis (Case I).

ligated, and amputated. This evidently was the hard body felt before operation at the lower end of the mass. The membrane around the cæcum was transversely divided and longitudinally sutured, as done before at the hepatic flexure. Layer suture of abdominal wound. Uneventful recovery. Discharged Nov. 27.

In May, 1911, the patient presented himself once more, complaining of recurrent mild attacks of pain in the right iliac fossa. He had gained flesh but was becoming constipated again. In the absence of the "air-cushion symptom" and of erectile spasms, he was dissuaded from operation which he desired. He was

\* All the diagrams were made by the author in the operating room, directly after the operations.

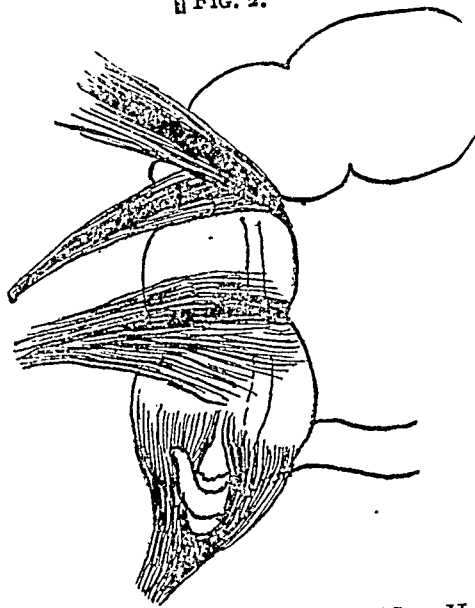
The form of adhesions observed in certain cases of chronic enterocolitis is so different from that just described, that in their case the use of the unqualified term "adhesions" is unfortunate, because misleading. While true adhesions involve at least the serosa, which is then replaced by more or less organized connective tissue, which often extends to the muscularis and mucosa, thereby causing absolute fixation of the adjacent segments, these other so-called adhesions do not enter into a close organic union even with the serous coating of the gut. They can be stripped off without difficulty, and, after their removal, the intact and glistening serous coat of the intestine is exposed. True, they do adhere, but in a very loose manner.

While dense adhesions may form between any two or more parts of the peritoneum, usually in close proximity to a destructive lesion, these veil- or cobweb-like formations have a typical site. They are invariably found on the lateral aspect of the cæcum, of the ascending and descending colon, or of the sigmoid flexure, beginning in the parietal peritoneum and radiating inward over the anterior aspect of the gut. The term "radiating" is peculiarly expressive, because their general arrangement is fan-shaped. Their attachment to the parietal peritoneum evidently represents the oldest part of the growth. This is attested by the presence of a narrow, glistening, fibrous band of tissue, which runs parallel with the longitudinal axis of the gut, and assumes a scalloped outline whenever the gut is pulled inward. The scalloping is produced by the fact that certain portions of the membrane are shorter than others, so that traction upon these shortened fibres accentuates this unevenness. We also find these shortened strands are thicker and more massive than the rest of the membrane, and further, when the gut is distended by gas, they cause visible tranverse indentations of lesser or greater depth, which often produce considerable narrowing of the intestinal lumen. Their substance is a glossy, transparent, myxoma-like, almost colorless tissue, within which, from the base to the periphery, a well-defined system of ramifying



these two bands was an open falciform pocket into which the finger could be introduced for an inch and a half. Slight pressure caused the sudden protrusion of the apex and distal two inches of a normal looking appendix. The base of the appendix was covered by membranous material which was easily wiped off. All the bands just described were divided wherever they diminished the lumen of the gut. Those around the appendix were removed together with that organ, which was absolutely sound. The wound was closed completely. Uneventful recovery. Cessation of all colicky symptoms. Discharged January 1, 1911.

FIG. 2.



Membranous bands present in Case II.

*Epicrisis.*—Though the duration of the disorder was not as long as that of the previous case, the anatomical changes and symptoms were of a pronounced character. The lesser intensity of pain might be explained by the absence of congestion of the cæcum and ascending colon. The lack of marked inflammatory changes here was assumed to indicate a colitis of rather benign type. The absence of fever and the good condition of the patient confirmed this view. And yet, with a mild colitis, there was a prodigious development of pseudoperitoneal membrane, the expression of an advancing proliferation, a process which had begun to cause stenosis and intestinal erection and which must be ascribed to irritation from materials absorbed

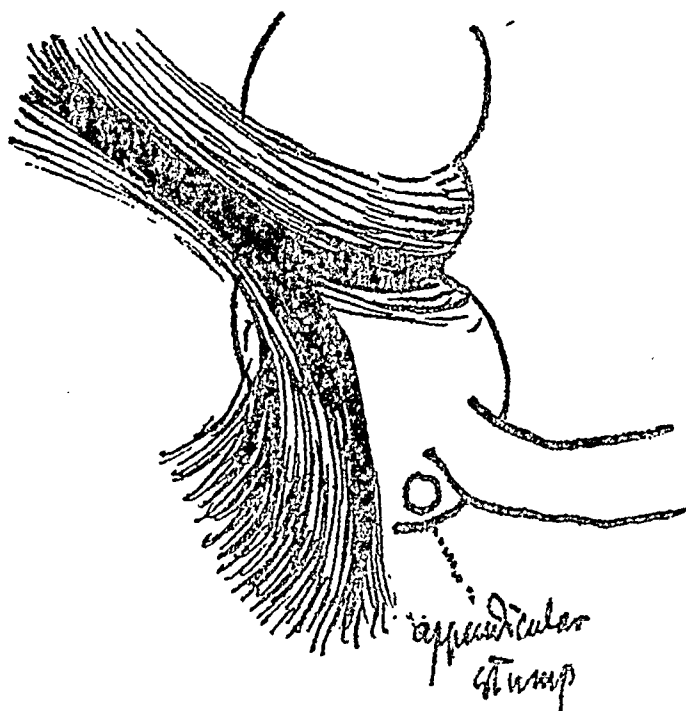
empty and contracted.<sup>1</sup> A similar, though less pronounced arrangement exists at the hepatic flexure (Glenard). The resistance offered by the splenic flexure on one side and by the closure of the ileocæcal valve on the other, renders consecutive peristaltic and anti-peristaltic locomotion of intestinal contents between these points possible. If through certain influences, this normal or quasinormal retardation becomes exaggerated, undue desiccation will take place above the splenic flexure, and with this, at first occasional, later on frequent, and finally, habitual constipation follows. With a preponderant meat diet, the nature of the bacterial flora of the cæcum and colon are modified; <sup>2</sup> putrefactive processes then engender catarrhal changes in the mucosa, leading both to the penetration of the intestinal tissue by pathogenic micro-organisms, and to the absorption into the circulation of their products as well as those resulting from decomposition of food remnants and secretions.

This sequence of events is attested by the fact that in persons suffering from habitual constipation, over-copious meals containing much meat are followed by attacks of severe colic, mainly located in the region of the cæcum, relieved by abundant stools containing both old solid and recently formed fecal matter. Very often these attacks of colic have a most alarming character, consequently they are apt to lead to erroneous diagnoses and ill-advised operations. The chief location of the pain and of the resistance to touch simulating a solid tumor is in the cæcal region. Under such circumstances a diagnosis of acute appendicitis has often been made, and operation has revealed a perfectly normal appendix and a greatly distended colon. Here, after operation, attacks have continued to recur as before. In other instances, where the appendix was found to be really diseased, its removal nevertheless did not free the patient from recurrent and violent attacks of cæcal disorder. The explanation of this is, that the appendicitis was the secondary, though most pronounced and urgent part of the process, while its fundamental element was the colitis. The marked symptoms of the complicating appendicitis over-

along the outer edge of which it again became united with the parietal peritoneum (Fig. 3). A thickened, rib-like portion of this membrane suggested comparison with the rib and beard of a feathered plume. There was a noticeable constriction of the gut above the cæcum. The membrane was easily separated from the colon, tied off, and removed. Cigarette drainage to appendicular stump and layer suture of wound. The temperature immediately fell to 101.8° F., and steadily descended to the normal. Drain removed on third day; no suppuration. Discharged, healed, on January 13, 1911.

*Epicrisis.*—The presence of extensive and retracted membrane indicated that the colitis must have preceded the attack of acute appendicitis by some time; appendicitis masked the colitis.

FIG. 3.



Pseudoperitoneal membrane; present in Case, III.

CASE IV (Surg. No. 120,661).—Sarah K., aged twelve; school girl; Russian. Admitted February 12, 1911.

Two years previously she had been operated upon for appendicitis at another hospital. She remained at that institution nine days. The colicky pains, the tenderness in the right iliac fossa, and the obstinate constipation from which she suffered disappeared for a little while after operation, that was, only as long

for so-called cæcum mobile in 43 cases.<sup>4</sup> Of these, 75 per cent. were cured, 16 per cent. improved, and 9 per cent. remained unimproved.

That the element of excessive mobility alone is not adequate to explain the symptoms of Wilms's so-called cæcum mobile, seems to be admitted by the reasonings contained in an excellent article on the same subject by his assistant Stierlin,<sup>5</sup> who concedes, that mobility of the cæcum was observed in from 10 to 23 per cent. of a series of cadavers, in which all evidence of intestinal trouble was lacking. A number of years ago both Wandel and Curschman called attention to the frequency of a long attachment of the cæcum, a condition that in itself is symptomless and may be accidentally found at autopsy.

*Habitual constipation is an indispensable factor*, a factor which will determine attacks similar to, if not identical with, those of Wilms's cæcum mobile syndrome; and this, in cases (my own observation) where the attachments of the cæcum were not only not too long, but where the cæcum was actually bound down by true adhesions. It may be readily admitted that undue mobility, by facilitating distention through lack of support, and by exaggerating the effect of compression by bands, can increase resistance to the expulsive efforts of the cæcum. The presence of these factors aggravates the pain of colic here.

The question of the first cause of the trouble is still undecided. A congenital redundancy of the large gut is undoubtedly a predisposing element, but it seems that in the majority of cases the resultants of an improper way of living constitute the evident cause. These comprise not only habitual errors of physical hygiene,—of which those of diet hold the foremost rank,—but also faults of mental and moral régime, the emotions, through the glandular secretions, having a most important influence upon the processes of digestion, absorption, and assimilation.

The well-known vicious circle of enteroptosis, chronic colitis, autointoxication, and neurasthenia need not be dwelt

upper angle of the abdominal incision (*a*, Fig. 4). This band formed the upper edge and thickest part of a membrane, such as we have previously described. The bulging distended portion below, and the shrunken and empty segment of the gut above the line of constriction presented a striking contrast. The empty gut above became visible only when the overlapping, dilated portion below was pulled aside. Complete section of the membrane, including its thickened upper margin, was carried along the outer line of reflection of the gut, and effected a complete liberation of cæcum and colon. The stump of the appendix, which had been removed at a previous operation, presented nothing unusual. Closure of abdominal wound. Uneventful, rapid recovery, with cessation of the previous symptoms, which had furnished the indication for the operation. The patient was instructed to observe a strict diet and to use castor oil in small doses for a long time. Discharged February 25.

*Epicrisis*.—The short convalescence after the first operation and the small scar permit the inference that the appendix could not have been the seat of a very severe inflammation. Colitis had evidently preceded the appendicitis. After all, was there any appendicitis?

CASE V (Surg. No. 121,594).—Abraham H., aged thirty-six; fur-cutter; Roumanian. Admitted March 31, 1911.

Habitual and obstinate constipation of many years' standing. During the past two years there had been twelve attacks of colicky pain, principally centred in the iliac fossa. Three days before admission the present attack began with indefinite pains both in the right iliac and the left lumbar regions. There was nausea with much belching.

*Status Præsens*.—A violent attack of colic, lasting about an hour, occurred shortly after admission. There was nausea and sweating, but no fever. Tension of the right rectus was variable; it disappeared with cessation of colic. A tympanitic, tender, elastic swelling in the right iliac fossa emitted gurgling sounds on pressure.

*Diagnosis*.—*Chronic colitis with stenosis of the ascending colon; a possible chronic appendicitis.*

March 31: Laparotomy by the house surgeon, Dr. Greenberg, disclosed the presence of a continuous membrane extending from the right lateral parietal peritoneum across the cæcum and ascend-

French, and German literature. Cases of Tixier, Terrier, Poirier, Legueu, Bérard, Quénu, Walther, Routier, and Bergmann are quoted in abstract by Braun.<sup>7</sup> More recently both Payr<sup>8</sup> and Allard<sup>9</sup> have observed ulcerative changes and a complicated system of adhesions with stenosis at the splenic flexure, and marked, often enormous distention of the transverse and ascending, and an empty and shrunken state of the descending colon. A certain number of the patients were relieved by colo-colostomy, ileosigmoidostomy, or by the establishment of an artificial anus.

NOTE 2.—All the surgical measures, beginning from colopexy (Wilms), extending to colocolostomy, colosigmoidostomy, and culminating in Lane's heroic abolition of the entire large gut, are mere mechanical makeshifts applied to correct the mechanical factor of the later and latest phases of long-neglected processes, which might have once been prevented by a timely dietary régime and the simplest medication. In verity, our triumphs in connecting and disconnecting tubes and receptacles are but a sort of glorified plumbing.

### CONCLUSIONS

1. The peritoneum reacts to the infectious processes ordinarily associated with chronic colitis, by the formation of characteristic vascularized transparent membranes (pseudoperitoneum), which take their origin along the external lateral aspects of the cæcum, ascending colon, and hepatic flexure on one side, and the sigmoid flexure, descending colon, and splenic flexure on the other.

In a general way, this line of origin runs parallel with the long axis of the gut, and the tissues deposited along this line represent the oldest constituents of the membrane. The membrane extends transversely across the gut, and, often reaching to the inner reflection of the peritoneum, completely envelops the intestines in a system of fan-like, radiating bands, between which the thinner parts of the membrane are outstretched like webs. Except at the flexures, constriction by one or more thickened bands of membrane is rarely marked enough to provoke ileus-like symptoms. However, flexion of a lax, unduly dilated, and abnormally movable portion of

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- <sup>1</sup> Otto Roith: "Die Füllungsverhältnisse des Dickdarms," Anat. Hefte. I. Abthlg., 1902, vol. xx, p. 19.
- <sup>2</sup> Carrière: Report in Schmidt's Jahrb., vol. cclxvi, 1900; and Rolly, D. med. Woch., 1906, No. 43.
- <sup>3</sup> Wilms: "Das Cæcum mobile," etc., Deutsch. med. Wochenschr., 1908, No. 41; and "Fixation der Cæcum mobile bei Fällen von Sogen. chron. Appendicitis," Zentralbl. f. Chir., 1908, No. 37.
- <sup>4</sup> Steirlin: "Das Cæcum mobile als Ursache," etc., "und die Erfolge der Colopexie," Deutsch. Zeitschr. f. Chir., Bd. cvi, p. 474.
- <sup>5</sup> *Loc. cit.*, p. 413.
- <sup>6</sup> Bittorf: "Über Pericolitis," Mittl. a. d. Grenzgebieten, 1909, vol. xx.
- <sup>7</sup> Braun: "Über den durch Lage und Gestaltsveränd. des Colon bed. Darmverschl.," Deutsch. Zeitschr. f. Chir., vol. lxxvi, p. 555.
- <sup>8</sup> Payr: Therap. Monatshefte, 1909, No. 23.
- <sup>9</sup> Allard: "Über gutartige Stenose an der Flexura coli sin.," Med. Klinik, April, 1911.

He had been more or less constipated since early boyhood; for the past 18 months, attacks of obstinate constipation had become more and more severe; these attacks ended in severe general colicky pain, which became most marked in the ileocæcal region. During each one of these attacks a painful and hard tumor was observed in the iliac fossa; this softened after cessation of the paroxysm but did not disappear. The paroxysms continued at short intervals until copious evacuations of hard, then soft fæces ended the attack. A mucoid, slightly bloody diarrhœa (10 to 15 stools per day) followed for three or four days, gradually diminishing until constipation again set in. Considerable loss of flesh and strength.

*Status Præsens.*—A fairly nourished, somewhat anæmic man. Lungs, heart, and large glands of the body were normal. The abdomen was soft and flat, except in the right iliac fossa, where a tympanitic, tender, soft tumor was felt, which became rigid and painful under repeated palpation. The pain was colicky and ended coincidentally with the termination of erectile effort of the mass which evidently consisted of the cæcum and the lower portion of the ascending colon. The tumor was laterally movable to a moderate extent, and presented a roughly cylindrical outline which however varied both in size and contour during the different fits of pain. Under all circumstances, a hard, cord-like projection could be felt extending downward from the lower pole; this, unlike the rest of the mass, remained sensitive to pressure during the intervals of intestinal repose. There were moderate elevations of temperature. Urinary findings were negative.

*Diagnosis.*—*Chronic colitis, with chronic stenosis of hepatic flexure; possible inflammatory tumor of ileocæcal region, or chronic appendicitis. A neoplasm was excluded.*

November 15: Laparotomy through right rectus; the incision was made four inches long, to permit of an adequate examination. The cæcum and ascending colon were much dilated by gas and fæces, their walls were somewhat congested and thickened. A thick, solid band was seen extending from the parietes downward and inward to the hepatic flexure, crossing it, and forming a pronounced point of obstruction (Fig. 1). Considerable manual pressure was needed to propel gas past this point. The thickest



tention but flabby abdominal walls. The pulse and temperature were normal. An indefinite tumor mass was palpable in the left iliac fossa. Slight tenderness and rigidity were palpable on the right side of the abdomen over the appendiceal region. Rectal examination demonstrated no mass, but was followed by the discharge of a small quantity of bloody mucus. On March 14, as the case was thought to be one of intussusception, operation was advised and accepted.

*Operation.*—An incision four inches in length was made through the left rectus muscle and peritoneum, exposing the descending colon, exhibiting a mass about three inches above the sigmoid flexure. Upon examination this mass proved to be an intussusception of the descending colon. The intussusception was reduced by gentle manipulation, whereupon it was discovered that there was present in the colon a firm mass, which by manipulation could not be displaced upward or downward to any marked extent. The colon was then incised over the mass and a purplish-colored tumor, two and one-half inches in length by one and one-half inches in diameter, was exposed, arising apparently from the mucous membrane of the wall of the colon. The tumor was attached to the wall of the bowel by a short, broad pedicle, having its origin from more than one-half of the circumference of the intestine. Owing to the extensive surface of attachment of the tumor, it was decided that resection of the bowel was necessary to secure its complete removal. Accordingly, about two inches of the colon, including the attachment of the tumor, were excised, and the divided ends of the gut were brought together and held in apposition by a Murphy button. A gauze drain was introduced to the site of anastomosis and the wound closed by tier sutures.

The patient did well after the operation. On the thirteenth day following operation an X-ray examination showed that the button had passed into the rectum, from which it was removed. The wound closed on the fifteenth day and the patient was discharged from the hospital on May 8. Her physician reports that she has been in good condition since leaving the hospital, and is well at the present time.

*Pathological Report.*—Specimen is an irregularly oval mass of tissue measuring approximately  $2\frac{1}{2}$  by  $1\frac{1}{2}$  inches in its two diameters. The exterior of the tumor is covered by mucous membrane, which in places

further advised to resume the dietary régime previously followed, which he had lately neglected to observe.

*Epicrisis.*—Though the local and most conspicuous symptoms disappeared for awhile, the chronic colitis remained uncured and required attention. The appendicitis here was undoubtedly secondary to the long-standing colitis. It would be absurd to expect that removal of a diseased appendix could cure a colitis; yet this was and still is taught by a number of surgeons.

CASE II (Surg. No. 119425).—Hyman T., aged thirty; clerk; Austrian. Admitted December 12, 1910.

Bowels constipated for several years past; chronic cough for four months; no hæmoptysis, expectoration, or night-sweats. No loss of weight. Five months ago he had an attack of violent abdominal pain (his first), lasting two days and relieved by catharsis. Since three weeks repeated attacks of similar character set in, the first one relieved by a laxative, the later ones recurring although the bowels were kept open. No blood in stools, no urinary symptoms.

*Status Præsens.*—General condition excellent. Physical examination revealed no abnormalities, except in the abdomen, where a tumor of the right iliac fossa was visible. This was movable, soft, and tympanitic. Prolonged palpation caused striking signs of intestinal erection with moderate colicky pain. Between spasms, slight pain on palpation was present all over the cæcum. No fever.

*Diagnosis.*—*Chronic colitis; chronic stenosis of hepatic flexure. The question of appendicitis was left open, since no definite appendicular signs were present.*

December 15: Laparotomy, Kammerer's incision four inches long. The ascending colon was found distended and bound to the parietes by two systems of pseudoperitoneal membrane; an upper aggregation, consisting of two bundles, which were rather massive and firm, constricted the hepatic flexure. Lower down, another fan-like membrane compressed the middle portion of the ascending colon, causing a deep indentation there. Below the caput coli, a stout, glistening mass ascended from the pelvic parietes and bifurcated about an inch from the cæcum (Fig. 2). Its mesial branch spread over the tænia coli, and its lateral one extended over the external portion of the cæcum. Between

segment just below it. An attempt was made to relieve this invagination, but it was found impossible to do so. It was, therefore, decided to resect this portion of the colon. It was found necessary, in order to facilitate the subsequent anastomosis of the two portions of the bowel to resect practically the whole of the descending colon, together with the splenic flexure, after which it was very easy to appose the transverse colon and the sigmoid flexure. The intestine was divided with the actual cautery between two clamps and the divided ends invaginated into the lumen after the manner of the treatment of the stump of an appendix. A lateral anastomosis was then performed in the usual way.

The patient made a good recovery, with the exception of an infection in the lower angle of the abdominal wound, which necessitated the reopening of this angle and healing by granulation. He left the hospital on March 1, 1911, in excellent condition, with a healed wound.

*Pathological Report.*—Examination of the specimen showed a lipoma of the size of an English walnut or larger, arising from the mesenteric border of the intestine. The lipoma was somewhat pedunculated, and had gradually encroached upon the lumen of the bowel, until finally it had almost occluded it, and in the effort of the intestine to pass on the obstruction, a partial intussusception had been brought about. The surface of the lipoma was gangrenous with some ulceration, which had evidently given rise to the bloody mucous stools prior to the operation. The microscopic examination of the tumor revealed nothing but fat and fibrous tissue.

The following cases of intussusception due to lipoma have been collected after a painstaking search through literature. They number but 19, exclusive of the two included in this article, and in reviewing the individual cases, for the sake of brevity, attention has been directed merely to the notation of the reporter, with his reference, the age, sex, prior history of the patient, the character of the onset of the attack, condition of intestines, rectal and abdominal findings, operation, site and pathology of the tumor, and the result of the case.

1. MECKEL (*Handbuch der Pathol. Anat.*, Leipzig, 1816) reports a case of his father's, where a lipoma caused an intestinal invagination.
2. Virchow (*Die krankhafte Geschwülste*, 1863, Band i, p. 382) reports the case of SANGALLI, where two submucous lipomata were found in

from the interior of the intestine. These facts suggest that the peritoneum reacts in one way to concentrated toxins from an acute bacterial invasion, and in another way to the toxic substances derived from putrefying intestinal contents. Combined forms of these two processes must, of course, be very common, and hence tend to confuse matters.

CASE III (Surg. No. 119,732).—Rosa G., aged twenty; bookkeeper; born in United States. Admitted December 29, 1910.

She had been constipated for several years, and had suffered from periodical attacks of sharp bellyache, relieved by laxatives. Menses normal. Continuous dull aching pain in right flank for some time. Two days previously diffuse colicky pains set in all over the abdomen; she vomited four times. The following day the pain became excruciating and most marked in the right iliac fossa. She vomited again.

On admission temperature 102.4° F., pulse and respiration somewhat accelerated, anxious facial expression. Well nourished. Lungs, heart, and upper organs of abdomen negative; urine normal. Abdomen moderately distended; right rectus rigid, hence palpation unsatisfactory. No dulness over iliac fossa. Per rectum no mass felt, but right side of pelvis very painful to touch.

*Diagnosis.*—Chronic colitis of old standing. Recent appendicitis; the fever, local muscular rigidity, vomiting, together with the absence of an exudate indicating an acute form without perforation.

December 29: Laparotomy. Kammerer's incision of three inches' length. The appendix was closely bound to the cæcum by recent, firm, very vascular adhesions; blunt separation of these was difficult and caused copious oozing. Both the appendix and the adjacent parts of the cæcum were intensely congested, thickened, and brittle. In tying off the base of the appendix, the ligature cut through the outer layers. Stump of appendicular mucosa was thoroughly charred with the actual cautery, then depressed, and buried under two tiers of sutures. Examination of the appendix showed a tight stricture close to the line of section, beyond which the lumen was distended by about half a drachm of thick, odorless pus; *empyema*. The outer side of ascending colon was invested by an extensive pseudoperitoneal membrane, originating as usual along the external line of reflection. It swept in a graceful curve downward toward the cæcum,

11. TREVES (Leipzig, 1888) reports the case of a female, aged eighty-three years, who had previous history of indigestion and colicky pain. Diarrhœa alternated with constipation, and finally a lipomatous polyp was discharged. Microscope confirmed diagnosis of lipoma.

12. STUDSGAARD (*Nord. med. Arkiv.*, 1894) reports a case of a female, aged forty-two years. Laparotomy displayed an irreducible intussusception of the jejunum, requiring resection. Patient died of peritonitis in five days. Pathological diagnosis: polyp, lipoma.

13. MARCHAND (*Berlin. klin. Wochenschrift*, No. 6, p. 135. Aertzlich, Verein zu Marburg, Case 3, 1896) cites case of a male, aged twenty-three years, who gave the previous history of having fallen on side while dancing. Onset was marked by acute pain, vomiting, and symptoms of intestinal obstruction. An enterostomy was performed on the fifth day for supposed obstruction; ileocolic into descending colon; death. Pathological examination demonstrated a subserous lipoma of cæcum.

14. HILLER (Bruns, *Beiträge zur klin. Chirurgie*, 1899, xxiv, p. 509) reports the case of a male, aged fifty-one years. The attack began with occasional pain and vomiting, constipation, rectal tenesmus, and moderate abdominal distention. At operation, attempt at reduction of iliac invagination produced a tear, necessitating resection and end-to-end anastomosis. Patient died. Pathological examination showed the intussusception to be due to a submucous lipoma.

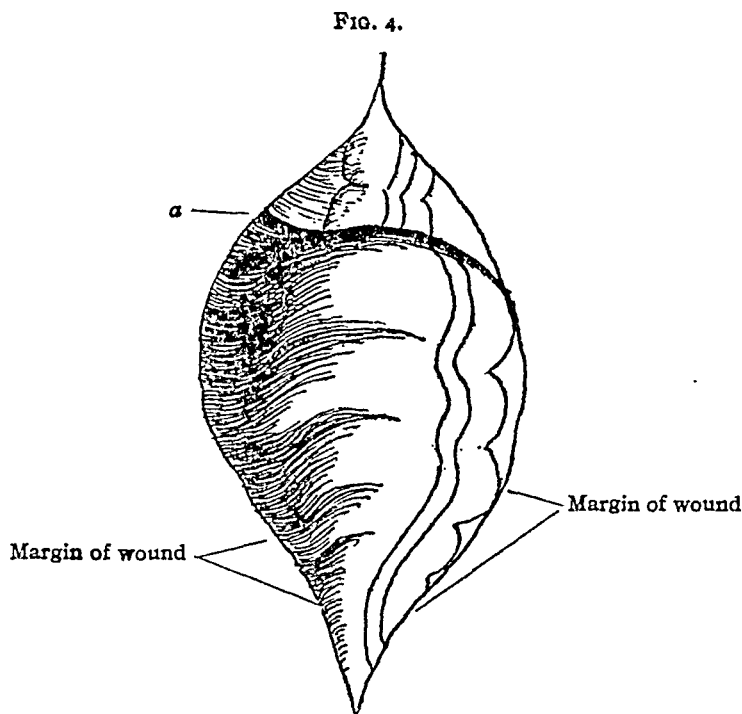
15. BRUNNER (Bruns, *Beiträge zur klin. Chirurgie*, 1900, xxv, p. 344) reports the case of a male, aged fifty-one years. His attack consisted of pain of six days' duration, absolute constipation, rectal tenesmus, blood and mucus, abdominal distention and rigidity, and palpable tumor within sphincter ani. Operative procedure consisted of removal of tumor per anum, followed by laparotomy and colostomy, with subsequent closure of artificial anus. Patient recovered. Pathological diagnosis: submucous lipoma.

16. HAASLER (Langenbeck, *Arch. f. klin. Chirurgie*, 1902) reports the case of a male, aged twenty-five years. Attack was of one week in duration, beginning with sudden pain, vomiting, and diarrhœa. Rectal examination revealed pus, and a tumor was palpable to the left of the umbilicus. Operation consisted of resection of transverse colon and removal of mass, size of three fists. Pathological examination demonstrated a submucous lipoma at apex of intussusception. Recovery.

17. ZUM BUSCH (*Cent. f. Chir.*, 1903, p. 733) reports the very interesting and unique case of a male, aged twenty-one years, who for fourteen months had dull pain about umbilicus, with alternating constipation and diarrhœa. The patient was an athlete, accustomed to holding several men upon his abdomen. The acute attack began with vomiting, associated with frequent fluid stools and great tenesmus. Tumor was demonstrable and rigidity was present in the lower right quadrant. Rectal examination revealed blood. Laparotomy displayed a gangrenous condition of the bowel, rendering reduction difficult and demanding resection, followed by side-to-side anastomosis. Intussusception proved to be ileocolic and contained a tumor. The tumor proved to be an inverted Meckel's diverticulum, with a subserous lipoma at apex. Recovery.

as she was kept on liquid and soft diet. There was occasional vomiting. Pains were worse at night, and especially bad after meals. No urinary disturbance. Menstruation had not set in.

*Status Præsens.*—General condition fair. Choreiform movements of head, neck, and hands. Lungs negative. Systolic cardiac murmur at apex. Abdomen slightly distended; a vertical scar of right iliac region; no hernia. In the right iliac fossa an elastic, non-movable tympanitic mass was felt. Pressure on



Dense, thick band constricting colon in Case IV.

this was painful, and elicited a succession of gurgling sounds. Pulse and temperature normal. Urine normal.

*Diagnosis.*—*Chronic colitis with chronic stenosis of ascending colon or hepatic flexure.*

February 21: Laparotomy. Excision of the entire scar; this was not adherent to the cæcum. Caput coli and about five inches of the ascending colon were closely invested by an extensive system of pale, almost translucent and scantily vascularized peritoneal pseudomembrane. A tense, balloon-shaped dilatation involving the cæcum and lower part of the ascending colon was evidently caused by a dense, thick band visible at the

for the adult as well, there are certain anatomical factors, associated with or without trauma, which play an important rôle in the production of intestinal invagination. They are the difference in diameter of the ileum and cæcum, prolapse of the mucosa of the ileum, abnormal mobility of the mesentery, benign and malignant tumors of the intestine, intra-intestinal foreign bodies, and finally certain para-intestinal appendages, as appendices and inverted Meckel's diverticula.

Of these causes producing acute intestinal obstruction due to intussusception we will consider only lipoma. A review of the 21 cases abstracted above reveals the fact that there are only seven successful laparotomies, involving a resection or an enterotomy; of these the present report contributes two. Although 12 recoveries are recorded, and the result not stated in three, in a number of the cases it will be seen that either a spontaneous cure occurred by sloughing away of the intussusception, or an excision of the intussusception and tumor per rectum was performed. Six patients died. Below are tabulated the seven successfully laparotomized cases of intussusception due to lipomata producing acute intestinal obstruction.

It is noteworthy that the mortality is highest when the attack is very acute and the obstruction complete; also, that when the onset is not so sudden the lipoma is larger, but located in the colon, having a large lumen. An analysis of the cases relative to the location of the lipomata demonstrates the following:

Cæcum . . . . .	1
Descending colon . . . . .	3
Ileocolic . . . . .	2
Ileum . . . . .	1
Jejunum . . . . .	1
Rectum . . . . .	3
Sigmoid . . . . .	4
Transverse colon . . . . .	1
Not stated . . . . .	5

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21

Obviously, we cannot agree with Eliot and Corscaden ("Insussusception, with Special Reference to Adults,"

ing colon. Its most massive portion involved the hepatic flexure. The pale appendix, which was not adherent, was five inches long. It was removed, and examination of its interior showed nothing abnormal. The membrane was left intact, and the abdomen was closed. Uneventful recovery. Patient was discharged April 12, with directions as to diet and régime. He was requested to report from time to time, so that the effect of simple removal of the appendix might be studied.

*Epicrisis.*—This was another case in which colicky attacks due to chronic stenosis might have induced a superficial observer to diagnose appendicitis, or that phantom, appendicular colic. It will be interesting to see in this case, whether the removal of a practically normal appendix will or will not cure a chronic colitis. The simple excision of an obliterating or obliterated appendix has been credited with such a marvellous efficacy in curing almost all the ills of the gastro-enteric tract *by reflex action*, that a critical revision of accepted opinions might well repay the trouble. It is held that minute changes in an appendix, many of them suggested, or rather dictated by enthusiastic surgeons to the minds of complacent and accommodating pathologists, provoke by reflex action "hyperacidity, pylorospasm, true pyloric stenosis, cardiospasm, acute and chronic colitis, and even chronic pancreatitis with jaundice, cholecystitis and cholelithiasis." The appendix, in short, has become a sort of biblical black sheep, which can conveniently be charged with as many unexplained ills of the human fabric as were formerly the uterine appendages. (The superior convenience of the appendix for this purpose is evident, since it is owned by both sexes.)

The marvellous cures of remote disorders ascribed to the removal of appendices showing chronic or obliterative changes, should be accepted on better warranty than that offered by the argument "post hoc, ergo propter hoc." Is it not possible, that the preparation for, and the régime following laparotomy is in many cases, the first serious and real regulation not only of the diet but of the entire trend of a heretofore perverse and irrational course of life; and this, notwithstanding the fact that such patients may have been surrounded for years by the solicitous care of "eminent specialists"?



ANNALS OF SURGERY, February, 1911) in the statement that "intussusception occurring in connection with benign growths in the large intestine are situated in either the sigmoid or rectum." These lipomata are usually single, but may be multiple, as in Sangalli's case. Histologically, they can be classified as subserous and submucous. The former arise from a hyperplasia of the epiplois appendices, which, by their growth may invaginate the bowel and then by traction provoke an intussusception. The latter are alleged to cause the largest lipomata occurring in the colon and rectum, and find their origin in the submucosa. Although in the majority of collected cases this differentiation is not noted, and of the cases where the variety is stated there are 5 submucous to 4 subserous; we believe that in the future with more complete and accurate histopathological examinations this order may be reversed.

The male sex has been slightly more frequently afflicted.

Aside from the fact that intussusception due to lipoma is a disease of adult life, age is no criterion, as the condition has been found at all ages from twenty-one to eighty-three, although usually prior to the fifth decade of life. There may or may not be a previous history of abdominal pain and intestinal stenosis. The symptoms are, of course, those typical of acute intestinal obstruction when the attack makes its appearance, not infrequently, however, preceded by a period of intermittent symptoms of partial obstruction. Commonly, the diagnosis of intussusception can be made by the exclusion of other possible causes, the presence of a palpable mass in the abdomen or rectum, and rectal tenesmus, blood, and mucus. The cause of the intussusception, however, is only discovered at operation or by the pathologist. The prognosis is always grave. It may be summed up in three words, the *deeper the better*, that is, the mortality is much less if the invagination occurs in the colon than if it takes place in the small intestine, and less in the descending than in the ascending colon.

The treatment of intussusception due to lipoma is always

# INTUSSUSCEPTION CAUSED BY A LIPOMA OF THE DESCENDING COLON.\*

ACUTE INTESTINAL OBSTRUCTION; RESECTION OF THE COLON.

BY HENRY R. WHARTON, M.D.,

OF PHILADELPHIA.

Surgeon to the Presbyterian Hospital.

INTUSSUSCEPTION, comparatively with other intra-abdominal surgical conditions, is an accident which may be regarded as rare. Benign tumors of the intestine provocative of intussusception are rarer, and acute intestinal obstruction due to intussusception caused by a lipoma is one of the rarest conditions to confront the surgeon.

A thorough review of medical literature reveals but 19 cases of acute intestinal obstruction due to this cause. Of these cases, treated variously, there are recorded only five recoveries following laparotomy. In view, therefore, not only of the rarity of this condition, which attracts more interest from the pathologico-anatomical than from the clinical standpoint, but also because of the few recoveries that have occurred after intra-abdominal intervention, it may be justifiable to report two other cases successfully operated.<sup>1</sup>

CASE I.—Mrs. J. C., aged thirty-three years, a patient of Dr. J. R. Crawford, was admitted to the Presbyterian Hospital, in my service, on March 13, 1908, with the following history: The patient stated that on March 9 she suffered from cramp-like pain in the lower abdomen, for which she took castor oil. This was followed by a fecal evacuation, but an increase in the abdominal pain. On March 11 she passed a stool containing blood and mucus. Vomiting also occurred on this date.

Examination upon admission demonstrated no abdominal dis-

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\* Read by title before the American Surgical Association, June, 1911.

<sup>1</sup> The second of these cases was brought to my attention by Dr. John M. T. Finney, of Baltimore, after this report had been undertaken, who has kindly permitted me to incorporate it in this article.

# SUPPURATION IN HALF OF A HORSESHOE KIDNEY.\*

BY JAMES E. THOMPSON, F.R.C.S.(Eng.),  
OF GALVESTON, TEXAS.

HORSESHOE kidney is not of very frequent occurrence. Both found it five times in 1630 autopsies at Basel (*i.e.*, in 0.3 per cent.); in 832 male cadavers twice (0.24 per cent.); in 798 females three times (0.37 per cent.). Although statistics vary, these figures may be taken as fairly representative, and we may expect horseshoe kidney in one cadaver out of 300. It will be seen that this is not quite a negligible quantity; and the frequency of the condition demands that at least a thought should be given to the possibility of its presence when dealing with any renal or obscure abdominopelvic tumor.

The case that forms the basis of this paper was one of pyonephrosis, occurring in a young girl fifteen years of age, who presented symptoms pointing very strongly to a diagnosis of renal calculus.

CASE I.—*History*.—A. M., aged fifteen, a well-nourished girl, came under my care in July, 1908. For six years she had suffered from pain in the left side. The situation of the pain was in the lower part of the lumbar region and the left iliac fossa. It was more or less constant, and was associated with irritability of the bladder, shown by frequent painful urination. At irregular intervals it was paroxysmal and very intense, at which periods it was accompanied by severe chills and high fever. No change had been noticed in the quantity of the urine, nor had the quality been altered up to two months before examination, when it became turbid and of an offensive odor. At no time had any blood been noticed in the urine, nor had gravel or anything resembling stones been passed. During the last two months the paroxysms of pain had been so frequent that the parents were very anxious for some medical treatment.

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\* Read before the American Surgical Association, June 19, 1911.

has undergone ulceration, most marked over its free end. A longitudinal section presents the oily surfaces of fatty tissue exhibiting a lobulated configuration. The consistency is that of ordinary compact adipose tissue. (See Figs. 1 and 2, demonstrating respectively the external and internal appearances of the tumor.)

Histologically, the appearance is represented by the microscopic drawing (Fig. 3). The mucosa, muscle, and a minute portion of the adipose tissue are clearly depicted. Although no area of ulceration of the mucosa is shown in this field, two foci of extensive inflammatory cellular infiltration are conspicuous in the mucous membrane. The microscope definitely establishes the subserous nature of the tumor, inasmuch as it is separated from the mucosa by the intervening muscular coat of the intestine.

*Diagnosis.*—Subserous lipoma.

CASE II.—Mr. J. D. W., aged thirty-five years, admitted to the Union Protestant Infirmary January 10, 1911, was operated on, and is reported here by the courtesy of Dr. John M. T. Finney, of Baltimore.

Upon admission, patient gave an absolutely negative previous medical history. His attack began five weeks prior to admission, with the history of having been awakened at 5 A.M. by pain in the abdomen, followed by several blood-streaked stools during the next two hours. Throughout the day he had frequent attacks of pain along the left side of abdomen. The following day he could feel an indefinite mass on left side, which disappeared in a few days. One week later patient began to pass two to three tablespoonfuls of blood with each stool. The stools averaged two to three per day for about three days, with the assistance of hot enemata. Patient had a third attack a week later. Two weeks ago he was admitted to the Charlotte Hospital, and received treatment by enemata, which was followed in two or three days by the passage of yellow mucus. For the last three weeks he has had pain just above the rectum and in the back. Slight tenderness upon pressure over the left side of the abdomen. Abdominal palpation was difficult because of rigidity of the muscles. No mass was palpable. The finding of tubercle bacilli in the fecal discharges prompted the diagnosis of tuberculous ulceration of the colon.

*Operation.*—Upon opening the abdomen a mass about the size of a lemon was found in the descending colon just below the splenic flexure. This mass first suggested an intussusception, as a portion of the wall of the colon was invaginated with the

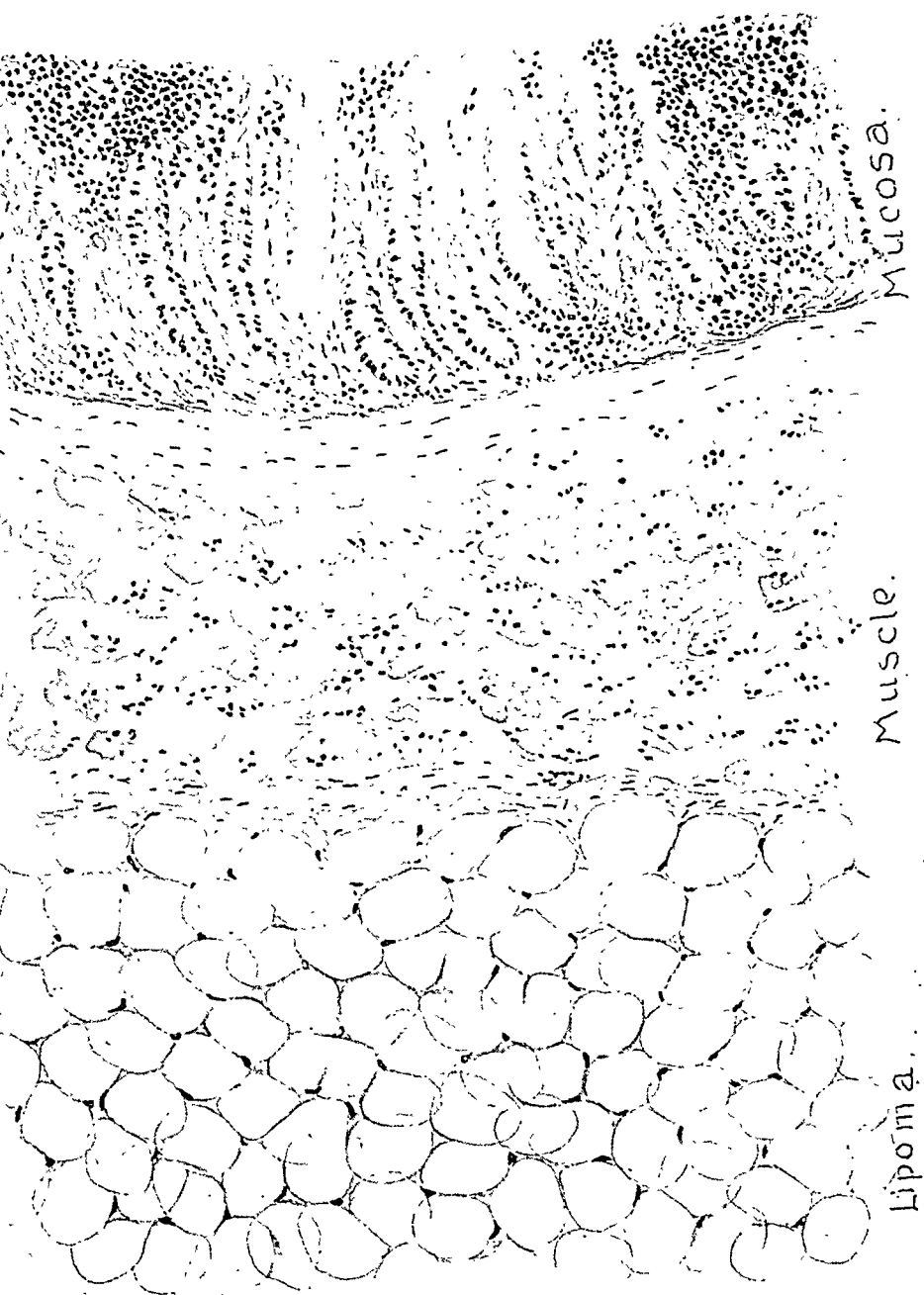
renal calculi. The cavities contained thin purulent urine, and were only moderately distended. No signs of calculi were discovered, nor was there any evidence of tuberculosis. The organ was flattened at the time of observation, and it was evident that drainage along the ureter had been very free.

It is possible that the kidney at one time had been the seat of one or more calculi, which at some time previous to the operation had become disintegrated and passed out without the patient's knowledge. But, on the other hand, it is just as probable that the case was one of primary hydronephrosis which had become infected secondarily with pyogenic organisms (colon bacilli), weight being given to this latter suggestion by the frequency with which horseshoe kidneys show evidence of hydronephrosis in greater or less degree.

The tendency of horseshoe kidneys to become diseased is very marked, and I have been able to find records of six cases of hydronephrosis (Socin,<sup>1</sup> Barth,<sup>2</sup> Israel<sup>3</sup> and Geiss<sup>4</sup>); of five cases of calculus (Phillips,<sup>5</sup> Braun,<sup>6</sup> Rumpel,<sup>7</sup> Israel and Schuchardt<sup>8</sup>); one case of sarcoma (Koenig<sup>9</sup>), and one case of pyonephrosia (Sutherland and Eddington<sup>10</sup>) unassociated with calculus. Of these only three can be characterized as cases of pyonephrosis (Phillips's, Braun's, and Sutherland and Eddington's). One (Sutherland and Eddington's) was a case of pure pyonephrosis unassociated with either tubercle or stone. In which respect it resembles the case that forms the subject of this paper. The other two were cases of calculus pyonephrosis (Phillips's and Braun's) and one of them is remarkable, owing to the fact that both sides of the kidney were infected and contained stones. Only one of the patients (Braun's) was operated on and this case proved fatal from hemorrhage, caused by tearing the left renal vein. The history of these three cases I have appended below.

CASE II (Reported by SUTHERLAND and EDDINGTON<sup>10</sup>).—The specimen was removed post mortem, from a male child, aged three years. Pus had been observed in the urine for two months before operation. An abscess in the lumbar region was opened, and continued discharging until death.

*Pathologic Specimen.*—The conjoined kidney was shown in section,



Histological drawing from microscopical specimen. This particular field shows no ulceration of the mucosa, but extensive inflammatory reaction. The subserous nature of the tumor is demonstrated by the interposition of the muscular coat of the intestine between the tumor and the mucosa.

passed a "mulberry" calculus the size of a haricot bean. He only once passed blood with the urine; this was at the age of 21. At 28 he became ill with cystitis and had never been quite well since. The urine became thick and sticky; there was pain in the loins and both groins, especially the right, which was worse after exercise. He had lost flesh during the last twelve months and had become very weak. He had been sent to the hospital with a diagnosis of intestinal obstruction. He was very sallow and in an extremely debilitated condition; the pulse was rapid and of very low tension. There was some indefinite resistance to be made out in the right hypogastric region, but no bulging in the loins. There was a history of nine days' constipation, and vomiting had become almost incessant. The urine was neutral in reaction, viscid, and half pus. The bowels were moved after repeated enemata. The bladder was sounded, but no stone could be detected. An operation on the kidneys was considered inadvisable on account of the great state of exhaustion.

*Autopsy.*—Kidney was found to be horseshoe-shaped, the two lateral portions being united below. On the right side the kidney was greatly distended, and formed a large cystic swelling. Both sides were firmly bound down by adhesions to the posterior abdominal wall. The right ureter was imbedded in a large mass of fat. On section of the right half of the kidney a large quantity of pus escaped, and nothing remained of the kidney substance but a thin-walled sac. Two faceted calculi were lodged in the commencement of the ureter. The left half, on section, was also found to contain pus; the pelvis was greatly dilated and occupied by a very large branching calculus, which extended into the kidney substance, so that the latter merely formed a thin coating for the stone. The weight of the kidney, including three calculi, after removal of the pus, was 22.5 ounces.

<sup>1</sup> Socin, A.: Eine Nephrektomie bei einseitig erkrankter Hufeisenniere, *Beitr. z. klin. Chir.*, 1899, iv, 197.

<sup>2</sup> Barth: Ueber Operationen an Hufeisennieren, *Verhandl. d. deutsch. Gesellschaft. f. Chir.*, xxxiii, Kong., 1904, p. 386.

<sup>3</sup> Israel: Palpationsbefunde bei Hufeisennieren, *Centralbl. f. Chir.*, 1904, No. 10, p. 302.

<sup>4</sup> Giss, Paul: Achtzehn Jahre Nieren-Chirurgie, *Diss.*, Marburg, 1889.

<sup>5</sup> Phillips, N. R.: Renal Calculus in Connection, with a Horseshoe Kidney, *Brit. Med. Jour.*, Feb. 21, 1903, p. 426.

<sup>6</sup> Braun, H.: Ueber Nierenextirpationen, *Deutsch. med. Wchnschr.*, July 30, 1881, p. 421.

<sup>7</sup> Rumpel, O.: Ein Fall von Nephrolithiasis bei bestehender Hufeisenniere, *Centralbl. f. Chir.*, 1902, xxix, 1091.

<sup>8</sup> Schuchardt: *Berl. klin. Wchnschr.*, 1892, xxix, 833.

<sup>9</sup> Koenig: *Deutsch. Ztschr. f. Chir.*, xl, 92.

<sup>10</sup> Sutherland and Eddington: Horseshoe Kidney in a Child: Pyonephrosis in One-half, *Tr. Glasgow Path. and Clin. Soc.*, 1899, vii, 47.

the descending colon, one being the size of a hen's egg and pedunculated, and had produced invagination and finally prolapse.

3. CASTELAIN (*Gaz. Hebdomadaire*, 1870, No. 20) reports the case of a male, aged forty-three years, who previously was troubled with habitual constipation. Attack began with loss of appetite, nausea and constipation, and rectal tenesmus. Presence of blood and mucus at anus was followed in the fourth week by discharge of a large pedunculated tumor, which proved to be lipoma. Recovery.

4. NINAUS (*Verein d. Aenzt in Steiermark*, 1871) cites the case of a male, aged thirty-two years, with previous history of intermittent attacks of pain for months. Present attack began with acute pain, vomiting for eight days, and constipation. On the eighth day blood was observed in the rectum. Was operated on twenty-sixth day. A discharge of slough was followed by recovery. Pathologically, the intestinal segment was found to have a lipomatous polyp. Obstructive symptoms recurred a year later and he was never well afterward.

5. ALBRECHT (*Petersb. med. Wochenschrift*, 1880, No. 9) reports the case of a male, aged fifty-one years. Attack began with pain, followed by diarrhoea. Mucus and blood were found by rectal examination. During the sixth week a pedunculated lipoma was discharged from large intestine.

6. VOIS (*Norsk. Mag. f. Lægevidere*, 1881) reports the case of invagination of the lipoma into rectum. The tumor was resected and the intussusception reduced by water injection.

7. MARCHAND (*Le Progrès Méd.*, 1882, No. 11, p. 202) records the case of a female adult. Attack was recurrent after nine months. Patient had absolute constipation. Rectal examination demonstrated a tumor 8 cm. from anus. Operation consisted of sigmoidostomy. Patient died. Autopsy revealed a lipoma at apex of intussusception.

8. BROHL-TUFFIER ("Invagination de S'iliaque dans le rectum. Lipome de l'intestin," *Le Progrès Méd.*, 1882) report the case of a female, aged forty-three years, having the previous history of increasing constipation for nine months and pain for four months in left inguinal region. Rectal examination revealed a tumor. Laparotomy displayed an invagination of S. romanum into the rectum. The intussusception was irreducible, and an inguinal colostomy was performed. Patient died of peritonitis on fifth day. Postmortem examination revealed an orange-sized, pear-shaped, pedunculated submucous lipoma located in the lower part of the S. romanum.

9. CLOS (*Thèse*, Paris, 1883) reports the case of a female, aged forty-five years. Attack began very acutely with typical symptoms of ileus, and patient speedily died in spite of artificial anus. Autopsy revealed a lipoma, size of an orange, located in the rectum, producing an invagination of the bowel.

10. BROHL (*Disserl. Würz.*, 1886) cites case of female, aged forty years. Patient gave the history of abdominal pain of fifteen years' duration. For a year prior to onset she experienced a sense of something coming down. Examination of rectum demonstrated descent of invaginated lipoma, later confirmed by histological examination.



11. TREVES (Leipzig, 1883) reports the case of a female, aged eighty-three years, who had previous history of indigestion and colicky pain. Diarrhoea alternated with constipation, and finally a lipomatous polyp was discharged. Microscope confirmed diagnosis of lipoma.

12. STUDSGAARD (*Nord. med. Arkiv*, 1894) reports a case of a female, aged forty-two years. Laparotomy displayed an irreducible intussusception of the jejunum, requiring resection. Patient died of peritonitis in five days. Pathological diagnosis: polyp, lipoma.

13. MARCHAND (*Berlin. klin. Wochenschrift*, No. 6, p. 135. Aerialich, Verein zu Marburg, Case 3, 1896) cites case of a male, aged twenty-three years, who gave the previous history of having fallen on side while dancing. Onset was marked by acute pain, vomiting, and symptoms of intestinal obstruction. An enterostomy was performed on the fifth day for supposed obstruction; ileocolic into descending colon; death. Pathological examination demonstrated a subserous lipoma of caecum.

14. HILLER (Bruns, *Beiträge zur klin. Chirurgie*, 1899, xxiv, p. 500) reports the case of a male, aged fifty-one years. The attack began with occasional pain and vomiting, constipation, rectal tenesmus, and moderate abdominal distention. At operation, attempt at reduction of iliac invagination produced a tear, necessitating resection and end-to-end anastomosis. Patient died. Pathological examination showed the intussusception to be due to a submucous lipoma.

15. BRUNNER (Bruns, *Beiträge zur klin. Chirurgie*, 1900, xxv, p. 311) reports the case of a male, aged fifty-one years. His attack consisted of pain of six days' duration, absolute constipation, rectal tenesmus, blood and mucus, abdominal distention and rigidity, and palpable tumor within sphincter ani. Operative procedure consisted of removal of tumor per anum, followed by laparotomy and colostomy, with subsequent closure of artificial anus. Patient recovered. Pathological diagnosis: submucous lipoma.

16. HAASLER (Langenbeck, *Arch. f. klin. Chirurgie*, 1902) reports the case of a male, aged twenty-five years. Attack was of one week in duration, beginning with sudden pain, vomiting, and diarrhoea. Rectal examination revealed pus, and a tumor was palpable to the left of the umbilicus. Operation consisted of resection of transverse colon and removal of mass, size of three fists. Pathological examination demonstrated a submucous lipoma at apex of intussusception. Recovery.

17. ZUM BUSCH (*Cent. f. Chir.*, 1903, p. 733) reports the very interesting and unique case of a male, aged twenty-one years, who for fourteen months had dull pain about umbilicus, with alternating constipation and diarrhoea. The patient was an athlete, accustomed to holding several men upon his abdomen. The acute attack began with vomiting associated with frequent fluid stools and great tenesmus. Tumor was demonstrable and rigidity was present in the lower right quadrant. Rectal examination revealed blood. Laparotomy displayed a gangrenous invagination of the bowel, rendering reduction difficult and demanding resection, followed by side-to-side anastomosis. Intussusception proved to be ileocolic and contained a tumor. The tumor proved to be an inverted Meckel's diverticulum, with a subserous lipoma at apex. Recovery.

18. RAY (*Lancet*, 1905, i, 567) cites the case of a female, aged thirty years, having had pain for six months in left iliac and lumbar regions, chiefly during and after defecation. For forty-eight hours previous to operation she had severe pain and vomiting. Enema caused tumor to protrude from anus. Operation consisted of reduction and removal of growth through enterotomy of sigmoid. Pathologically, a subserous lipoma was diagnosed. Recovery.

19. LORENZ (*Jahr. d. zw. ch. klinik.*, Wiesbaden, 1906-07, 41 to 44) reports the case of a male, aged fifty-eight years, whose attack began gradually with symptoms of chronic intestinal stenosis. A sausage-shaped, transverse, alternately hard and soft tumor was palpable in abdomen. Laparotomy revealed an ileocæcal invagination with tumor on ileocæcal valve. The lower ileum, cæcum, and ascending colon were resected. Pathological examination demonstrated lipoma. Recovery.

20. WHARTON reports a case of intussusception due to lipoma and causing acute intestinal obstruction. (See above, Case I.)

21. FINNEY reports an almost identical case. (See above, Case II.)

Although intussusception is in the vast majority of cases an accident of childhood, indeed, not more than 1 to 30 per cent. of cases occurring in adults, it is not proposed to digress from the subject under consideration further than to note that Clubbe (*The Diagnosis and Treatment of Intussusception*, 1907), in his splendid monograph on this subject, reports a personal experience with 144 cases, only 14 of which were over one year of age. One hundred and twenty-four laparotomies were performed, with a mortality of 32.2 per cent. In no case was a tumor, much less a lipoma, the cause of the intestinal invagination. Indeed, the etiological influence of tumor in the production of intussusception seems to be restricted entirely to adult life. These tumors may be benign or malignant. Under the benign may be classified polyp, lipoma, adenoma, fibroma, myofibroma, myxoma, myxofibroma, papilloma, and cyst. The tumor is practically always affixed to the apex of the invagination. The malignant tumors are essentially degenerations of primarily benign neoplasms.

It can be no longer doubted that simple intussusception is most always induced by irregular and increased peristaltic activity of the intestines. This explains why children, in whom peristalsis is most active, become the usual victims of this accident. On the other hand, not only for the child but

for the adult as well, there are certain anatomical factors, associated with or without trauma, which play an important rôle in the production of intestinal invagination. They are the difference in diameter of the ileum and cecum, prolapse of the mucosa of the ileum, abnormal mobility of the mesentery, benign and malignant tumors of the intestine, intra-intestinal foreign bodies, and finally certain para-intestinal appendages, as appendices and inverted Meckel's diverticula.

Of these causes producing acute intestinal obstruction due to intussusception we will consider only lipoma. A review of the 21 cases abstracted above reveals the fact that there are only seven successful laparotomies, involving a resection or an enterotomy; of these the present report contributes two. Although 12 recoveries are recorded, and the result not stated in three, in a number of the cases it will be seen that either a spontaneous cure occurred by sloughing away of the intussusception, or an excision of the intussusception and tumor per rectum was performed. Six patients died. Below are tabulated the seven successfully laparotomized cases of intussusception due to lipomata producing acute intestinal obstruction.

It is noteworthy that the mortality is highest when the attack is very acute and the obstruction complete; also, that when the onset is not so sudden the lipoma is larger, but located in the colon, having a large lumen. An analysis of the cases relative to the location of the lipomata demonstrates the following:

Cecum . . . . .	1
Descending colon . . . . .	3
Ileocolic . . . . .	2
Ileum . . . . .	1
Jejunum . . . . .	1
Rectum . . . . .	3
Sigmoid . . . . .	4
Transverse colon . . . . .	1
Not stated . . . . .	5
	21

Obviously, we cannot agree with Elliot and Gerster ("Intussusception, with Special Reference to Adults.")

## CASES OF INTUSSUSCEPTION DUE TO LIPOMA SUCCESSFULLY OPERATED BY LAPAROTOMY IN ACUTE INTESTINAL OBSTRUCTION.

Number	Reporter and year.	Sex.	Age.	Prior history.	Onset.		Conditions of intestines.	Rectal findings.		Abdominal findings.			Operation.	Site.	Pathology.	Result.	
					Acute.	Chronic.		Tumor.	Blood.	Mucus.	Tumor.	Distention.					Rigidity.
1	Brunner .... 1900	M	51	Negative	+	-	Constipation	+	+	+	-	+	+	a, Excision per anum b, Laparotomy c, Colostomy	Rectum	Submucous lipoma	Recovery
2	Hassler ..... 1902	M	25	Negative	+	-	Spurious diarrhoea	-	+	+	+	-	+	Resection	Transverse colon	Submucous lipoma	Recovery
3	Zum Busch.. 1903	M	21	Dull pain about umbilicus for 14 months	+	-	±	-	+	-	+	-	+	Resection	Ileocaecal	Inverted Meckel's diverticulum with subserous lipoma at apex	Recovery
4	Ray..... 1905	F	30	Pain on defecation for 6 months in left iliac and lumbar regions	+	-	Constipation	+	-	-	-	+	+	Colotomy	Sigmoid	Subserous lipoma	Recovery
5	Lorenz..... 1906	M	58	Symptoms of chronic intestinal stenosis	-	+	?	-	?	?	+	-	-	Resection	Ileocaecal	Lipoma	Recovery
6	Wharton ... 1911	F	33	Negative	+	-	±	-	+	+	+	-	-	Resection	Descending colon	Subserous lipoma	Recovery
7	Finney..... 1911	M	35	Negative	+	-	Spurious diarrhoea	-	+	+	-	-	+	Resection	Descending colon	Lipoma	Recovery

ANNALS OF SURGERY, February, 1911) in the statement that "intussusception occurring in connection with benign growths in the large intestine are situated in either the sigmoid or rectum." These lipomata are usually single, but may be multiple, as in Sangalli's case. Histologically, they can be classified as subserous and submucous. The former arise from a hyperplasia of the epiplois appendices, which, by their growth may invaginate the bowel and then by traction provoke an intussusception. The latter are alleged to cause the largest lipomata occurring in the colon and rectum, and find their origin in the submucosa. Although in the majority of collected cases this differentiation is not noted, and of the cases where the variety is stated there are 5 submucous to 4 subserous,<sup>1</sup> we believe that in the future with more complete and accurate histopathological examinations this order may be reversed.

The male sex has been slightly more frequently afflicted.

Aside from the fact that intussusception due to lipoma is a disease of adult life, age is no criterion, as the condition has been found at all ages from twenty-one to eighty-three, although usually prior to the fifth decade of life. There may or may not be a previous history of abdominal pain and intestinal stenosis. The symptoms are, of course, those typical of acute intestinal obstruction when the attack makes its appearance, not infrequently, however, preceded by a period of intermittent symptoms of partial obstruction. Commonly, the diagnosis of intussusception can be made by the exclusion of other possible causes, the presence of a palpable mass in the abdomen or rectum, and rectal tenesmus, blood, and mucus. The cause of the intussusception, however, is only discovered at operation or by the pathologist. The prognosis is always grave. It may be summed up in three words, *the deeper the better*, that is, the mortality is much less if the invagination occurs in the colon than if it takes place in the small intestine, and less in the descending than in the ascending colon.

The treatment of intussusception due to lipoma is almost

operative. Although a small percentage of cases have been and will be cured by spontaneous discharge of the intussusceptum and lipoma, to expect such a sequence would be the height of folly. Too much emphasis cannot be placed upon the earliness of operation. Care must be observed in attempting to disinvaginate the bowel, nor must much time be devoted to such an attempt. The best course is to reduce as much of the intussusception as may be quickly and easily accomplished, followed by enterotomy and the excision of the lipoma or intussusceptum plus lipoma, or preferably resection of the entire intussusceptum, which must necessarily be the procedure if the tumor has undergone malignant degeneration or has a broad sessile attachment to the intestine, or the gut is found to be gangrenous. On the other hand, if the patient be an adult and his condition precarious, inguinal colostomy or ileocolostomy may be performed advantageously. The operation of artificial anus as a palliative procedure for this condition in an infant should never be practised, as they invariably succumb. The lesser of the two evils is always to resect, although the prospect is hopeless. Should the lipoma and intussusceptum present at the anus, resection or excision per rectum, followed immediately by laparotomy to secure the continuity of the colon, is the preferable course to pursue.

## SUPPURATION IN HALF OF A HORSESHOE KIDNEY.\*

BY JAMES E. THOMPSON, F.R.C.S.(Eng.),  
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HORSESHOE kidney is not of very frequent occurrence. Both found it five times in 1630 autopsies at Basel (i.e., in 0.3 per cent.); in 832 male cadavers twice (0.24 per cent.); in 798 females three times (0.37 per cent.). Although statistics vary, these figures may be taken as fairly representative, and we may expect horseshoe kidney in one cadaver out of 300. It will be seen that this is not quite a negligible quantity; and the frequency of the condition demands that at least a thought should be given to the possibility of its presence when dealing with any renal or obscure abdominopelvic tumor.

The case that forms the basis of this paper was one of pyonephrosis, occurring in a young girl fifteen years of age, who presented symptoms pointing very strongly to a diagnosis of renal calculus.

CASE I.—*History*.—A. M., aged fifteen, a well-nourished girl, came under my care in July, 1908. For six years she had suffered from pain in the left side. The situation of the pain was in the lower part of the lumbar region and the left iliac fossa. It was more or less constant, and was associated with irritability of the bladder, shown by frequent painful urination. At irregular intervals it was paroxysmal and very intense, at which periods it was accompanied by severe chills and high fever. No change had been noticed in the quantity of the urine, nor had the quality been altered up to two months before examination, when it became turbid and of an offensive odor. At no time had any blood been noticed in the urine, nor had gravel or anything resembling stones been passed. During the last two months the paroxysms of pain had been so frequent that the patient was very anxious for some medical treatment.

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\* Read before the American Surgical Association, June 14, 1911.

*Examination.*—The urine was slightly alkaline; specific gravity 1022; contained quantities of pus. It was free from tubercle bacilli, but contained myriads of colon bacilli. There were no crystals. Physical examination revealed very little. No swelling could be felt in either loin or groin, but pressure in the left iliac fossa elicited some pain.

*Operation.*—As the child had never menstruated and was extremely nervous, no vaginal examination was made, but an anæsthetic was given and arrangements made to do a radical operation if it was found necessary. Under the anæsthetic a slight swelling was found in the upper part of the left iliac fossa, and it was decided to make a low lumbar incision and explore it retroperitoneally. An incision was made like that formerly employed for the retroperitoneal exposure of the common iliac artery. A flattened cystic tumor was found lying in the iliac fossa and extending as far as the brim of the pelvis. Absence of the left kidney was demonstrated in its normal lumbar position, so it was decided that the tumor was probably a misplaced kidney. While it was being exposed and isolated, an opening was accidentally made into one of the cystic swellings, out of which pus flowed. The interior of the cysts was now explored, but no stones were found. That it was without doubt the kidney was easily shown by the blood-vessels, which entered the mesial and upper border, while the ureter came out of the same border and coursed over the front of the swelling on its way to the bladder. While the lower end of the kidney was being isolated, it was seen to narrow materially into a kind of neck and then to expand immediately into a mass that lay transversely over the front of the last lumbar vertebra. Thinking of horseshoe kidney, I examined this mass carefully, and satisfied myself that it was the right kidney. A clamp was applied to the narrow neck, the intervening glandular tissue was crushed, and a ligature applied in the groove, after which the left diseased kidney was removed. The ureter was very short (about  $1\frac{1}{2}$  inches long), and it was ligatured close to the bladder, the cut end being disinfected with phenol.

Convalescence was uninterrupted, the right kidney being able to carry on the excretory functions without difficulty.

*Pathologic Specimen.*—The removed organ was a typically dilated pyonephrotic kidney, exactly the counterpart of many kidneys the seat of



renal calculi. The cavities contained thin purulent urine, and were only moderately distended. No signs of calculi were discovered, nor was there any evidence of tuberculosis. The organ was flattened at the time of observation, and it was evident that drainage along the ureter had been very free.

It is possible that the kidney at one time had been the seat of one or more calculi, which at some time previous to the operation had become disintegrated and passed out without the patient's knowledge. But, on the other hand, it is just as probable that the case was one of primary hydronephrosis which had become infected secondarily with pyogenic organisms (colon bacilli), weight being given to this latter suggestion by the frequency with which horseshoe kidneys show evidence of hydronephrosis in greater or less degree.

The tendency of horseshoe kidneys to become diseased is very marked, and I have been able to find records of six cases of hydronephrosis (Socin,<sup>1</sup> Barth,<sup>2</sup> Israel<sup>3</sup> and Geis<sup>4</sup>); of five cases of calculus (Phillips,<sup>5</sup> Braun,<sup>6</sup> Rumpel,<sup>7</sup> Israel and Schuchardt<sup>8</sup>); one case of sarcoma (Koenig<sup>9</sup>), and one case of pyonephrosis (Sutherland and Eddington<sup>10</sup>) unassociated with calculus. Of these only three can be characterized as cases of pyonephrosis (Phillips's, Braun's, and Sutherland and Eddington's). One (Sutherland and Eddington's) was a case of pure pyonephrosis unassociated with either tubercle or stone. In which respect it resembles the case that forms the subject of this paper. The other two were cases of calculous pyonephrosis (Phillips's and Braun's) and one of them is remarkable, owing to the fact that both sides of the kidney were infected and contained stones. Only one of the patients (Braun's) was operated on and this case proved fatal from hemorrhage, caused by tearing the left renal vein. The history of these three cases I have appended below.

# SURGICAL TREATMENT OF FISTULA IN ANO WITHOUT MUTILATION OF THE SPHINCTER.

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THE object of this study is not to advocate a new method, because it would appear that in the search of new methods in this, as in all branches of surgery, it is found that "there is nothing new under the sun."

The writer of late has found a few cases of anal fistulæ in which a departure from present standards has seemed to be productive of results, apparently shortening the term of treatment and obviating the disagreeable consequences of the radical operations at present in vogue. The fact that the method has been used mainly in inveterate cases, which in some instances had resisted all manner of topical and operative treatment over long periods of time, furnishes the hope that the method proposed will fit into a large enough number of cases to justify its *raison d'être*.

It is not intended to include in the scope of this study all varieties of fistulæ that are found affecting the rectum and its neighborhood. Obviously enough it is proper to exclude those forms which are strictly extrinsic and which originate, for example, in diseases of the pelvic bones, diseases of the bladder, prostate, urethra, and other contiguous organs and parts which extend very readily to the perirectal tissues and ultimately invade the bowel, simulating very closely the types under consideration.

For the same reason fistulæ that have a specific constitutional origin are excluded, except the tuberculous forms which afford special indication for the method of treatment herein advocated.

tula in ano consists of the complete division of the structures involved between the two ends of the fistulous tract, and in the incomplete forms the rule has been to create a terminal orifice by force either within or without and lay bare the tract, forcing the surface to heal by granulation.

In the case of simple, submucous anal fistula the method is without fault. In the varieties of rectal fistula, having their internal terminus without the bounds of the internal sphincter or between the sphincters, the method is also applicable, notwithstanding the fact that even in these cases a partial loss of sphincter control occasionally results.

In that group of cases in which the fistulous tract has its internal orifice beginning at some point within and above the internal sphincter or in some part of the rectal wall the effect of the complete section of the structures involved always results in some degree of impairment of sphincter control, causing very often a state in which there is much inconvenience and discomfort, if not abject misery.

Methods of operation have been devised to obviate these results, but almost without exception the treatment of fistula in ano stands as it stood one hundred years ago.

The first and practically the only radical departure from old methods was the complete resection of the fistulous tract beyond its bounds and its subsequent suture. This method has been successful in selected cases generally speaking, when the infective process had ceased in a single, direct, fistulous tract, rendered sterile through lapse of time. It has failed so often and so frequently made a bad state worse that it is safe to say that the tendency of surgeons is to abandon it. It is absolutely contraindicated in infective states and in complex rectal fistulæ.

A study of the distribution and direction of rectal fistulæ based upon anatomic lines of cleavage is all-important in this study. Rectal fistulæ undoubtedly originate within and without the bowel. A streptococcus or mixed infection of the integuments covering the buttocks will sometimes penetrate

the planes of fascia, and, following the trail of the lymphatics and vessels, and lines of least resistance, lead to the rectal wall and penetrate. That complete and incomplete forms of fistulæ with all manner of ramifications may originate in this way is without doubt.

The greatest number of fistulæ of the type with which this study deals originate within the bowel, and the internal orifice of the tract will be found in most cases at the anorectal junction, generally speaking within the posterior quadrant of the anal ring.

The sequence of events is: (1) diminished resistance, (2) trauma, (3) invasion of micro-organisms, (4) ulceration, (5) perforation, (6) infiltration of the fat layers, (7) formation of abscess. The spread of the abscess afterward and its final localization determine the fistulous tracts and zone.

It is believed that fully three-fourths of all rectal fistulæ originate within the lumen of the bowel. The tendency of fistulæ which result from ischiorectal abscesses originating without is to perforate the rectal wall above the level of the external sphincter; whereas, rectal fistulæ which result from abscesses originating within the bowel tend to perforate through the sphincters or between them.

The submucous and the combined submucous and subcutaneous varieties afford exceptions to this rule, rising as they do at times to high levels in the rectal walls.

Stercoral or pressure ulcers are sometimes found in the sigmoid and rectum, which perforate and cause perirectal abscesses.

In the service of a colleague at the present time is a case of fistula, the outer opening of which is in the right groin, the internal opening beyond the reach of the sigmoidoscope, situated probably in some part of the colon. Water forced into the rectum makes its escape freely through the fistulous tract. The history of this case makes it evident that the ulcer was the result of chronic constipation.

When an ulcer perforates the rectal wall and an abscess emerges, its course and spread are determined by various

factors. If the abscess is small, the resistance strong, and the inflammatory action moderate, it may take a straight course to the surface and point, leading to the formation of a single, straight, direct tract, which after a variable period of activity will contract and form a canal with a dense, limiting, fibrous wall.

This is the simplest type of fistula and is amenable to easy surgical cure, yielding readily even to proper topical treatment. Such fistulæ as these, because of their accessibility, will often yield to the use of Beck's paste, which obviously enough would not avail in the treatment of the complex forms herein referred to.

The superimposed and concentric arrangement of the fat layers in the buttocks and perirectal region has a very important influence in determining not only the boundaries of any forming abscess, but the direction and distribution of the succeeding fistulous tracts; thus, an abscess which has left the rectal wall may course into the deepest layers of the fat next to the gluteal muscles, and in this plane of fat and connective tissue, divide and subdivide into branches, which, turning hither and thither, become lost in blind ends in the fat, giving no evidence of their existence by any palpable or visible signs without; draining, however, toward the skin and finding an outlet at or near the anal margin. In like manner the abscess may emerge from the point of perforation in the rectal wall in any one of the well-marked layers of connective tissue or occupy each layer definitely.

In other instances the spread and distribution of the fistula is general, with all the fat layers and fossæ involved, the whole region then becoming literally honeycombed with fistulous tracts, all draining toward a common point without.

This tendency of rectal fistulæ to follow definitely the planes of tissue is even seen in the most superficial varieties, which are typified in those not uncommon forms in which the abscess and its succeeding fistulæ are strictly submucous, subcutaneous, or both combined.

In peri-, retro-, and ischiorectal abscesses the lines of cleavage are followed in the same general way. In the first two varieties the abscess may take a course upward and perforate the rectal wall above the sphincter level or even above the levator ani muscle, or course downward and point in the usual situation. In the former event the discovery of the fistula may be difficult; in the latter it may be mistaken for and incorrectly treated on the same lines as the so-called blind external fistula.

The most complex form of rectal fistula is that which, on one or both sides of the rectum, has branches like the tentacles of an octopus, passing into the various fat fossæ surrounding the bowel and burrowing deep into the fat layers covering the buttocks, having, perhaps, only one outlet. This type of fistula, which on the surface may have all the earmarks of a simple fistula, may be approached by a radical process of treatment with a very reasonable prospect of complete cure, but not by the methods commonly in vogue.

The examination of a large segment of the buttock which was resected for the cure of one of the cases referred to in this study illustrates in a striking manner the tendency of anorectal fistulæ after perforating the rectal wall to occupy one or other or all of the fat layers by branching in various directions, at times pointing to the surface but more frequently terminating in blind ends within the layers occupied, all converging like the branches of a river into one channel.

In the same specimen was seen, following the same distribution, many branching lines of cicatricial tissue, showing that some of the sinuses had healed, while others seemed to be in the course of a slow process of extinction.

Surgeons who have observed this complex type of fistula will agree that the operative measures in common use not infrequently fail even when the most radical steps are taken. The reason is plain. If a complete section is made of the fistulous tract into the rectum, including the division of one or both the sphincters, and all care is taken to lay

bare all visible and accessible tracts, if one of the many branching tracts remain, and it is impossible in many cases to note them all, it may be laid down as a law and for the most obvious reasons that the fistula will persist *in situ*. So often is this result observed that the fistula under the conditions named could very well be termed the "paradoxical" fistula.

Several cases have been observed in which apparently very complete operations were performed by different operators, and in all the last condition, if anything, was worse than the first, the fistula persisting *in loco* with some degree of incontinence a feature of all.

Why does the fistula persist? Plainly the answer is that, whereas the main fistula was properly attacked and a complete section made of the intervening tissue into the bowel, some remote branch or feeders some distance removed from the field of operation, concealed in one or other of the fat layers, remained to determine a relapse of the morbid process. The ultimate result of incontinence in these cases which was not the result of the first, but rather the continuous effect of the later operations, is explained on the ground that the first incision divided the external sphincter completely and the internal sphincter in part only, leaving enough power in both to control the bowel adequately; the succeeding operations performed in exactly the same region and on the same theory of treatment, dividing more and more of the internal sphincter, of necessity the time comes at last when the remnant of the sphincter is divided, incontinence thereupon resulting.

It will sometimes happen that the abscess on emerging from the rectal wall will invade both sides simultaneously, or if one side alone is invaded the process may readily extend to the opposite side, causing ultimately a symmetrical distribution of fistulæ of the character described in both buttocks.

To this group belong the several varieties of so-called

horseshoe fistulæ, which more than all other forms of complex fistulæ require radical treatment.

According to Tuttle, in general hospital practice in this era of advanced surgery, operative failures in a large number of cases investigated amounted to 45 per cent.

Proctologists inveigh against these figures and protest that the operations are performed by incompetents, which term includes surgeons, and that in their hands the figures indicating failure would be negligible or nil. Is this true?

Certain facts must be connoted: (1) The divulsion of the sphincter alone is known to cause incontinence, even when done with care and without apparent damage to the fibres of the muscles other than their undue stretching. (2) The single simple section of the two sphincters at a correct angle will sometimes cause incontinence, and there are added dangers when the section of the sphincter is associated with its previous complete divulsion. (3) The single, simple section of the external sphincter alone at a correct angle is also known to cause well-marked incontinence. (4) It is held by competent authorities that incontinence may be caused by division of one or other of the nerves supplying the parts in question. Unfortunately, for the force of this particular argument, anatomists have not yet made clear the exact manner of the end distribution of the nerve supply of this peculiar group of muscles. If one could imagine a single nerve-trunk reaching a circular muscle like the external sphincter and furnishing half of its circumference with the power of motion and control, one could readily understand that its division could easily be effected by a fortuitous cut properly directed with reference to mere technic and cause a hopeless paralysis of the part. However strong the asseverations of writers and others that operative failures and incontinence following surgical procedure are a reproach to surgery and a stigma on the particular operator who meets them, the fact remains that there are abundant reasons for their occurrence apart from any system of treatment, and that every surgeon and proctologist, if he tell the truth, will admit a



very considerable percentage of operative failures and an occasional case of incontinence as long, at least, as present surgical methods are in vogue.

It is thought that one of the factors that has retarded the progress of surgery in the treatment of anorectal fistulæ is the paramount position that has been given to the principle of drainage in the treatment of this disorder.

A minute study of a fistulous channel with all its ramifications reveals readily that its drainage is usually free, continuous, and sufficient, and that once the fistulous tract has been established, it is not subject to those complications which arise from defective drainage, and that even when the evidence is presented of defective drainage in the presence of a freshly formed abscess, careful scrutiny will show that it was not so much the result of defective drainage as renewed infection or reinfection of a part highly susceptible and continuously exposed to bizarre and multiform infective processes.

The state of perpetual unrest of the parts is the great predisposing factor and, on the other hand, in certain groups of cases infection is maintained *in loco* by repeated trauma, while in other reinfection takes place intermittently by the passage of fresh hosts of organisms from the neighboring bowel.

The principle of drainage is conceded to be paramount in the treatment of all abscesses that develop in the neighborhood of the rectum, and executed properly would in all cases prevent the development of fistulæ. It is held, on the other hand, that in the treatment of rectal fistulæ, in order to compass their radical cure, the principle of drainage must yield to some means which will do for the relief of fistulæ what drainage does for abscess, and this brings us to the consideration of a wider application of the principle of extirpation for the cure of fistula in ano than has been heretofore considered.

It is proposed to proceed by the following steps:

1. The patient is prepared in the most careful way as for any major surgical operation on these parts.

2. The sphincter is completely dilated.

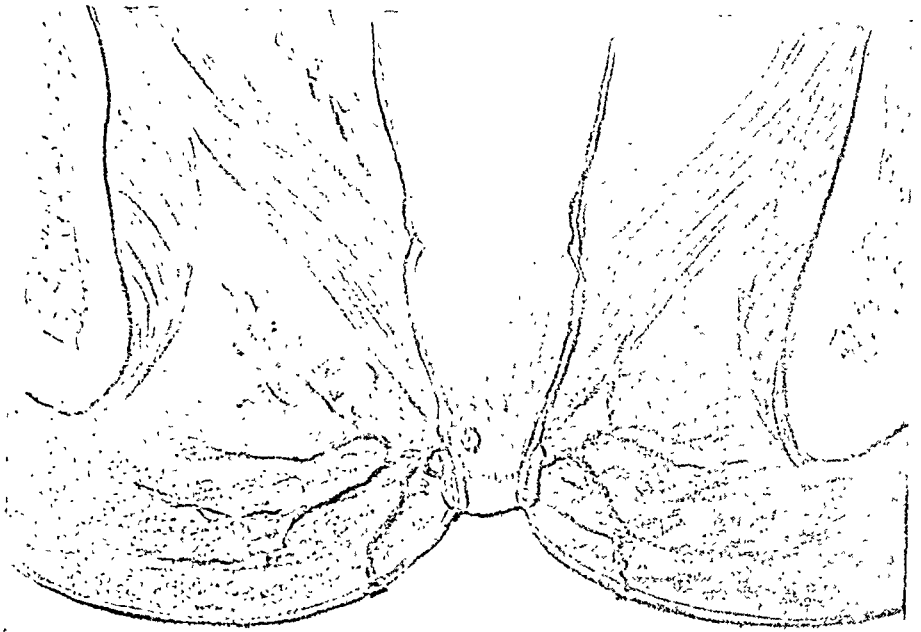
3. The internal orifice of the fistula is minutely examined and with a proper instrument is very cautiously dilated. After dilatation the mucosa is uplifted and pared with curved scissors in the direction of the long axis of the bowel, and with a small knife or fine scissors the circumference of the muscular layer is then trimmed and vivified. If need be, the opening may be incised or split in the direction of the circumference of the sphincter. After this has been done a few interrupted sutures of iodized catgut are introduced in the muscular layer at right angles with the sphincter, tied and divided. The mucous membrane is then sutured with interrupted chromic catgut or silk sutures, properly spaced. If more than one orifice exists, of course the same procedure is followed.

4. A flap is made on the side involved, beginning by making a small semilunar incision just beyond the border of the external sphincter, dividing the parts down to the fistulous tract, the latter being divided flush at its point of emergence from the bowel. The incision is extended from both ends of the first incision outward and made large and deep enough to include, if possible, under the eye all visible and accessible branching tracts. The exigencies of the case may require sometimes the lifting of one or other of the buttocks in its entirety.

In one case, already referred to it was necessary to make a complete flap and partial resection of both buttocks in order to reach the deepest and most distant branching tracts.

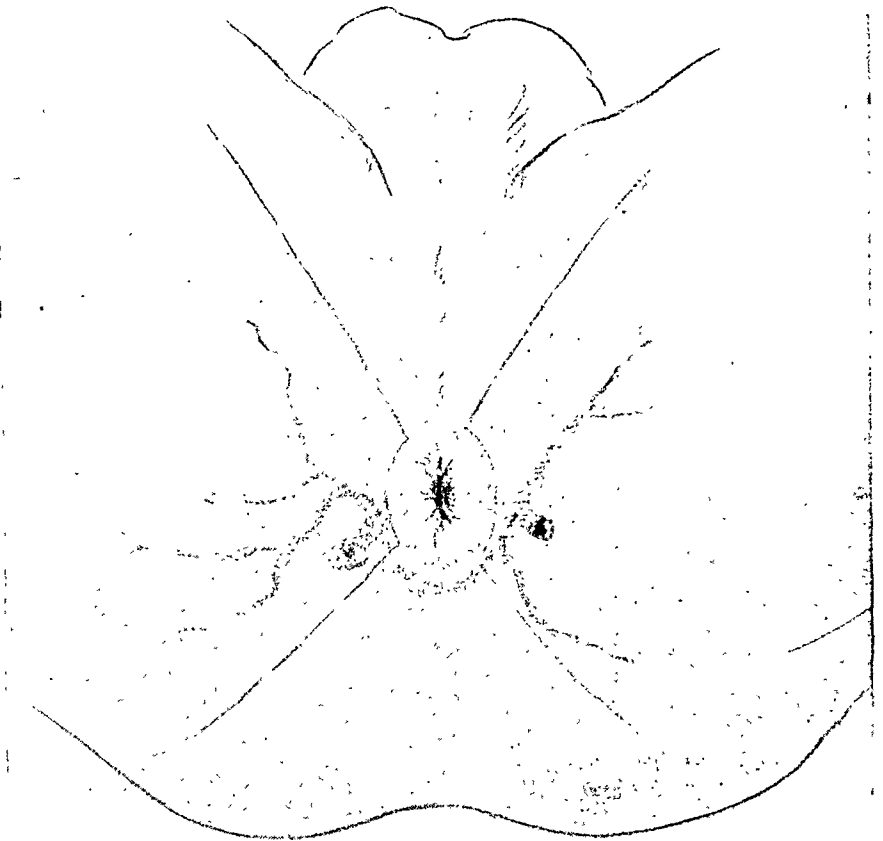
5. The opposite side of the rectal opening is now attacked, and after all doubtful tissues have been removed the rectal walls are infolded once or twice over the line of suture within. The greatest care must be exercised in removing all doubtful tissues. If need be the cautery could be used for

FIG. 1.



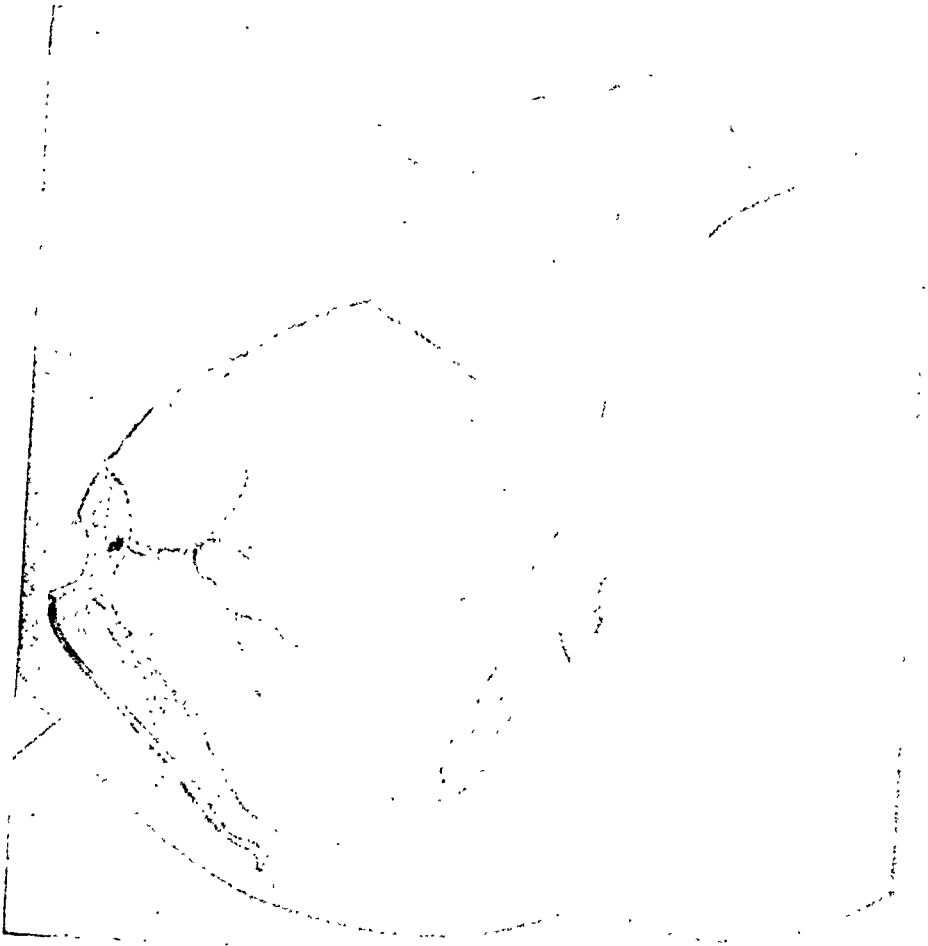
Sectional view of pelvis showing tendency of complex anorectal fistula to branch into any one or all of the concentric layers of fat in the buttocks and rectal fossæ, and to terminate in blind ends (diagrammatic).

FIG. 2.



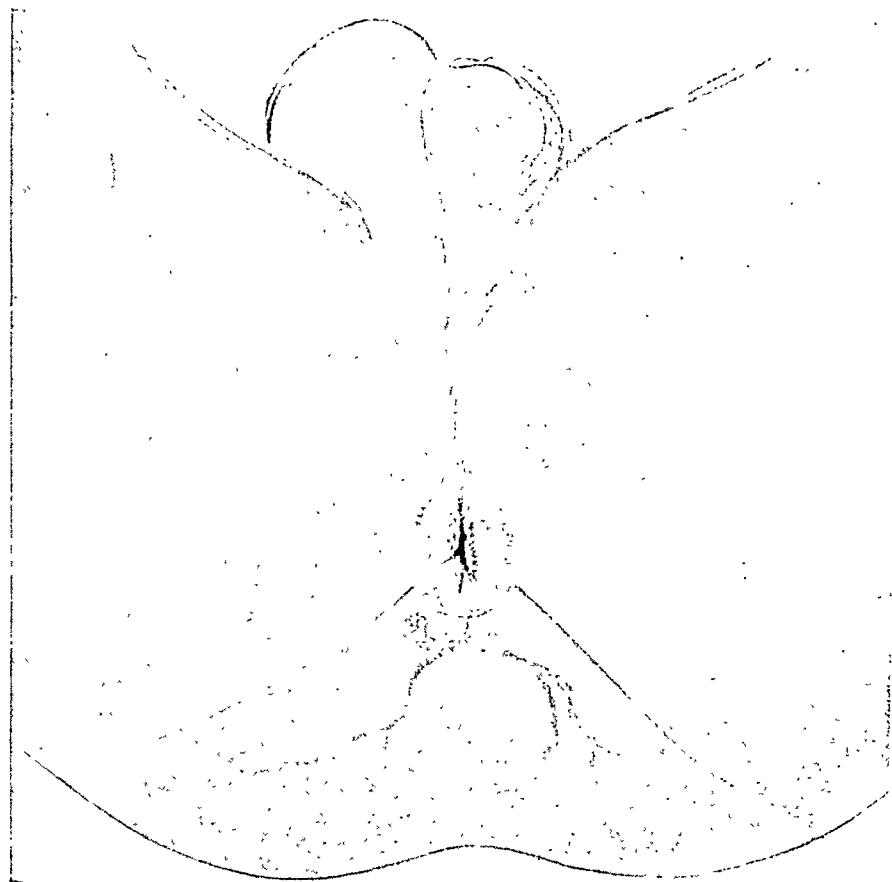
Proximate and distant branching and symmetrical spread of horseshoe fistula, having two orifices without opening within the bowel. Scheme of flap formation for adapted cases.

FIG. 4



Trap-door flap lifted and fistula with all membrane reflected outwards for  
extirpation and approach to the outside of the rectal layer.

FIG. 4.



Complex anorectal fistula tracking backward; branching scheme of flap formation for adapted cases.

FIG. 5.



Flap reflected with contained fistulous tract, preparatory to extirpation.





their complete destruction, or substituted entirely for the suture of these parts.

6. The exposed flap is next attacked with knife or large pointed scissors curved on the flat, and the original tract, its branches, and the entire fistulous zone including every branching tract resected. Careful search will be made in the ischiorectal fossa and perirectal spaces for any concealed tracts.

7. The whole field is then carefully flushed with normal salt solution, and, if need be, antiseptized and the fat layers sutured with buried catgut so as to close all dead spaces. In many cases the entire wound may be closed as in the case of breast amputation, or a small drain may be left for twenty-four or forty-eight hours.

REPORT OF TWO EXTREME CASES OF COMPLETE FISTULA (INVETERATE FORMS) RELIEVED BY THIS METHOD OF OPERATION.

CASE I.—W. G., aged seventy years, Civil War veteran. Developed in 1863 a rectal fistula on which many operations were done from time to time, the condition becoming more aggravated.

Original examination, September, 1909, revealed a single rectal gap with numerous branches extending into the ischiorectal fossæ on both sides and over the buttocks, branching under the skin on both sides of the scrotum and as high up as the groin, numerous openings discharging freely. Partial loss of control.

For relief of this case which had existed for forty-six years, both buttocks were lifted by large "trap-door" flaps and made to include as nearly as possible all branching tracts, resection of the fistula throughout the fat layers in the flaps, resection of all subcutaneous tracts with openings without. Suture of the rectum not necessary in this case. Partial resection of both flaps where tissues were unduly undermined. Replacement of the flaps by suture, closure of gaps by plastic procedure, moderate packing of open subcutaneous tracts. Complete healing of the entire area in three months. No recurrence.

CASE II.—Mrs. J. B., aged thirty-two years. *Horseshoe*

fistula, single opening in the posterior rectal wall at the ano-rectal junction, tracking backward toward the coccyx and sacrum, and branching into the fat of the gluteal folds, right and left. The condition had lasted four years.

Treated by incision on two or three different occasions. No rectal incontinence. The "trap-door" incision made behind the anus by method described, lifting the large flap which contained all branching tracts and scar tissue showing obliterated sinuses; complete extirpation of complete fistula; replacement of the flap; primary union. A slight shallow tract developed for a short time, which yielded very readily to moderate use of Beck's paste.

# EVERTED DORSAL DISLOCATIONS OF THE HIP.\*

BY OSCAR H. ALLIS, M.D.,

OF PHILADELPHIA.

WITH THE REPORT OF A CASE MISTAKEN FOR FRACTURE OF THE FEMORAL NECK.

BY JOHN B. ROBERTS, M.D.,

OF PHILADELPHIA.

IN this variety of dislocation the foot is everted, while the head of the femur lies outward upon the dorsum of the ilium. This form of luxation of the head of the femur may be primary or secondary. By primary I mean that the head of the bone escapes from the socket while the femur is in a condition of external rotation, and the dislocation occurs with all the signs of dorsal dislocation *reversed*. In other words, the ordinary dorsal dislocation is attended with adduction of the knee and rotation inward of the femur and foot, and when the patient lies on his back the trochanter will be on a higher plane than the dislocated head, with the latter pointing inward and downward; while in dorsal dislocation with eversion of the foot the femur will not be adducted nor will it be rotated inward, but both the femur and the foot will be turned outward, and the great trochanter, instead of being on a higher level than the dislocated head, will be at a lower level when the patient is in the supine position.

I have seen one case of undoubted primary inverted dorsal dislocation of the hip.

A middle-aged man was leading a horse on a smooth icy road, when the animal reared, slipped, and fell. The horse fell upon the man, rendering him instantly helpless. He was conveyed to his home by a policeman, and through the courtesy of Dr. W. Stillwell I saw him an hour after the injury, before any attempt had been made at reduction. The limb was abducted

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\* Read before the American Surgical Association, June 19, 1911.

and flexed slightly at the hip and knee, occupying a constrained position, with the foot turned outward. The reduction was accomplished under ether in the following way: The pelvis of the patient, lying on his back, was first fastened securely to the floor by means of muslin bandages passed through hooks in the floor, situated at the borders of the pelvis and at the perineum. The leg was flexed on the thigh, the thigh on the pelvis, and traction was made directly upward until the head of the femur reached the level of the socket. The traction was next made inward toward the umbilicus, in order to bring the head over the socket, then the knee was carried downward and the head of the bone was found to have come into place. The patient returned to work in a few weeks.

Experimental work has demonstrated the possibility of primary everted dorsal dislocations. With the cadaver strapped firmly to a suitable table, the femur should be flexed to a right angle with the pelvis and the leg at a right angle to the thigh. The operator, standing on the right side, should steady the right knee with his left hand, and, seizing the right ankle with the right hand should rotate the femur by turning the ankle like the spoke of a wheel inward toward the pubes, with the femur slightly adducted. The rotation ruptures the capsule and the head falls outward. Then if the limb is extended, the symptoms of dorsal dislocation with eversion will be present. I have repeatedly produced the luxation by this manipulation, but have quite as frequently fractured the femur in the undertaking.

The secondary variety may be produced through unspent forces, converting a primary dorsal with inversion into a dorsal with eversion, or as is not uncommonly the case, it may occur as the result of unsuccessful attempts at reduction by means of manipulation with circumduction. This method has repeatedly converted a dorsal dislocation into a pubic or obturator and not infrequently has converted a dorsal with inversion into a dorsal with eversion. In the case reported by Dr. Roberts, attempts had been made to restore motion to a joint stiffened by chronic synovitis. In doing so the

capsule, which was softened and weakened by inflammatory processes, gave way, dislocation took place, and in attempting to restore it the condition shown in the X-ray picture was produced.

CASE REPORT BY DR. JOHN B. ROBERTS.

A rather stout married woman, aged twenty-six years, was put under my care for surgical treatment at the Methodist Hospital in November, 1910. She was evidently in good general health, but was confined to bed in the supine posture, because of pain and rigidity of the right hip and knee. She was unable to move the limb, and complained of great pain when any attempt was made to handle it or make an examination by means of active or passive motions.

She was free from fever, had a good appetite, and was cheerful and happy, if allowed to remain undisturbed, lying on her back with the two lower limbs parallel to each other. The right lower extremity was slightly œdematous over the tibia, appeared to be somewhat atrophied, and lay upon the bed in marked eversion, with the heel about opposite the internal malleolus of the left tibia. Voluntary motion of the limb hurt her, she said, and therefore no movements were made. Attempts at rotation made by me caused her to cry out with pain or fright, though some rotation was evidently possible. Passive flexion of hip and knee were impossible, but how much of the rigidity was due to pain and fear I could not determine.

Measurements from teeth, umbilicus, or anterior iliac spines to the malleoli showed the right limb to be about  $1\frac{3}{4}$  inches shorter than the left. Measurements from the trunk to the patellæ and from the patellæ to the malleoli seemed to prove that about  $1\frac{1}{4}$  inches of the shortening existed in the femoral section of the limb and about  $\frac{3}{4}$  inch in the tibial section. These measurements, as is well known, are difficult to make with accuracy. Measurements to establish the relative position of the two great trochanters by the so-called Bryant's triangle gave about  $1\frac{1}{2}$  inches displacement upwards of the right trochanter. When the patient was turned on her abdomen the right buttock was flattened, and the right leg appeared to be shorter than the left from trochanter to heel by about  $1\frac{1}{2}$  inches. No kyphosis

of the spine was found, and no definite account of a fracture of the limb was obtained.

My attempts to obtain a clear history of the condition previous to my first interview were unsatisfactory. After eliciting the objective facts just mentioned, I concluded that the woman was suffering from an old fracture of the neck of the femur, a rigid knee from continued immobility in the extended posture, and a hysteroidal condition of the nervous system.

The antecedent hospital notes were surgically rather desultory; but from them the following information was obtainable: The patient had been admitted about six weeks prior to my seeing her. She had stated that the present trouble dated from January, 1910, when rheumatism occurred in both legs. It was more severe in the right hip than in the left, and increased so much that she became delirious. The right leg became swollen and œdematous. This condition had lasted until she was admitted to the hospital. Then the right knee was found to be stiff in the extended position, but the principal trouble was the great pain in the hip of the same leg. Temperature, pulse, and respiration were normal. The examination of the chest, abdomen, pelvis, and urine was negative, and nothing unusual was found in her menstrual history. No tubercle bacilli were found in the blood.

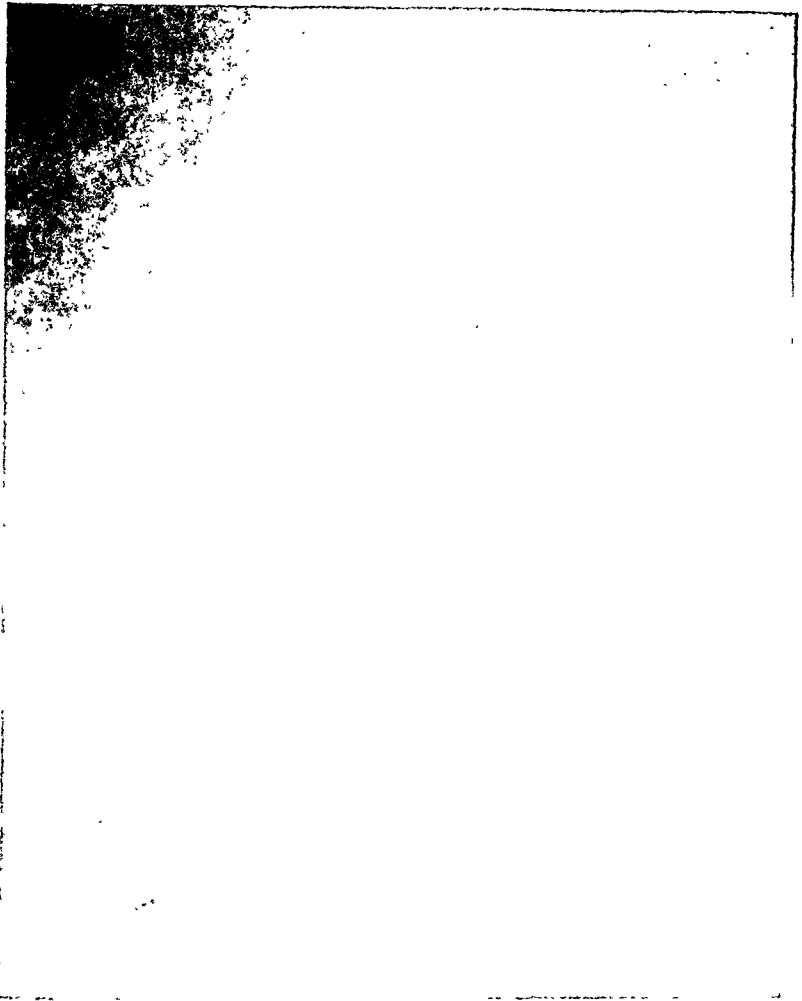
The woman herself gave as her opinion that the hip trouble might have developed from a fall sustained four or five days prior to the onset of the pains, which her family physician had called rheumatism. At that time she had bruised the left leg only, did not seem much hurt, and had walked freely afterwards.

Four years previously she had given birth to her youngest child, six weeks after which she had had what was called typhoid fever for a few days. Prior to these occurrences there had been a sore on the vulva, but no subsequent symptoms had developed.

When admitted to hospital the right leg was everted, being painful and tender over its whole extent and helpless as to voluntary motion or usefulness. The woman could not stand or walk and had been in bed for several months. There was slight pitting on pressure. Sensation was preserved. The right leg was somewhat smaller than the left in circumference, and is described in the hospital notes as being shorter than the left.

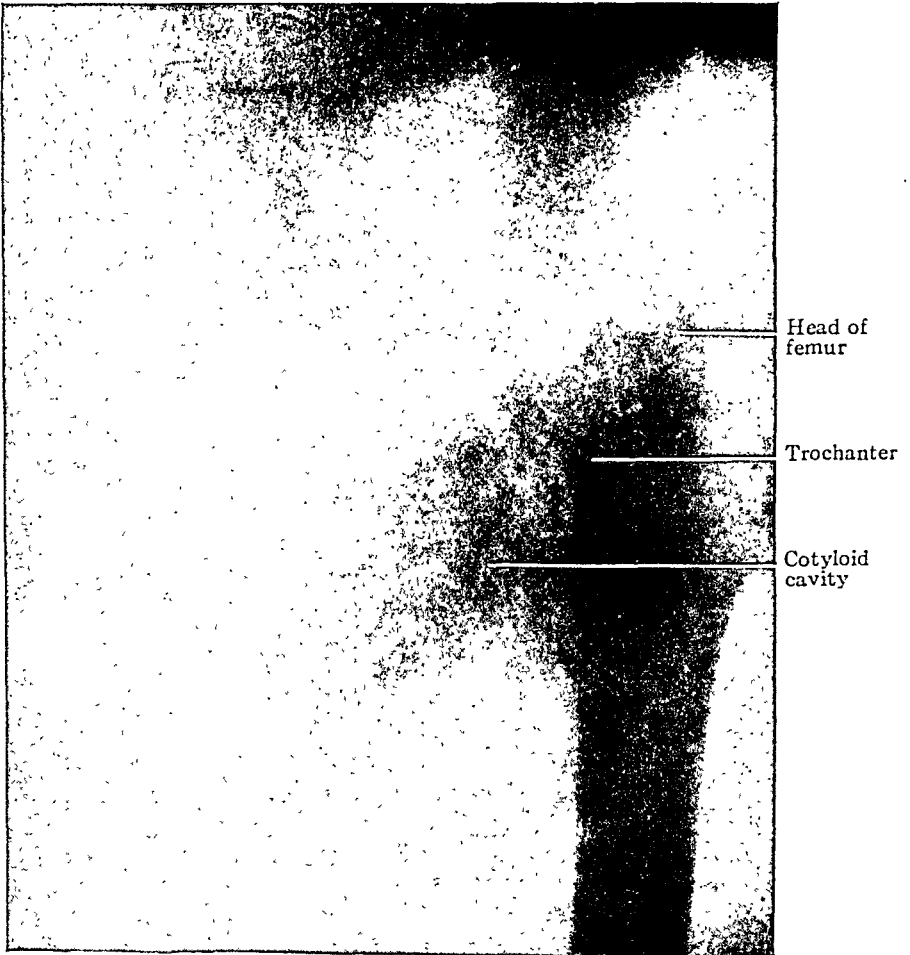
Some time after her admission an X-ray plate was obtained and the report made that the skiagraph was negative as to patho-

FIG. 1



Ankylosis from arthritis of right hip before manipulations caused dislocation. (Reversal of plate makes this appear to be left hip.)

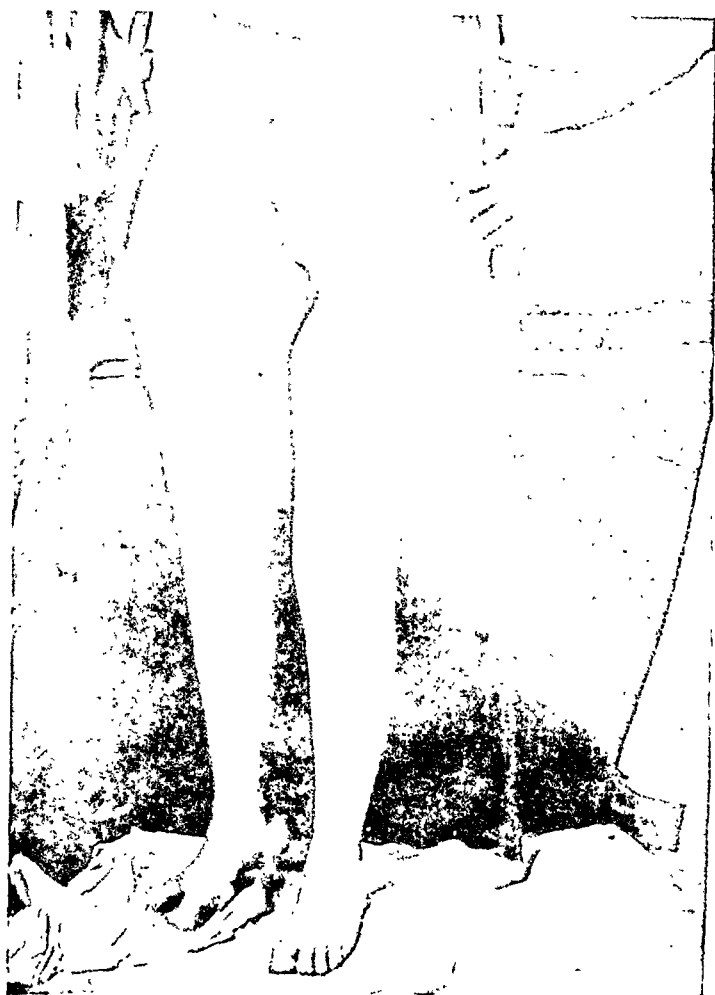
FIG. 2.



Everted dorsal (supracotyloid) dislocation of right hip. (Reversal of plate makes this appear to be left hip.)

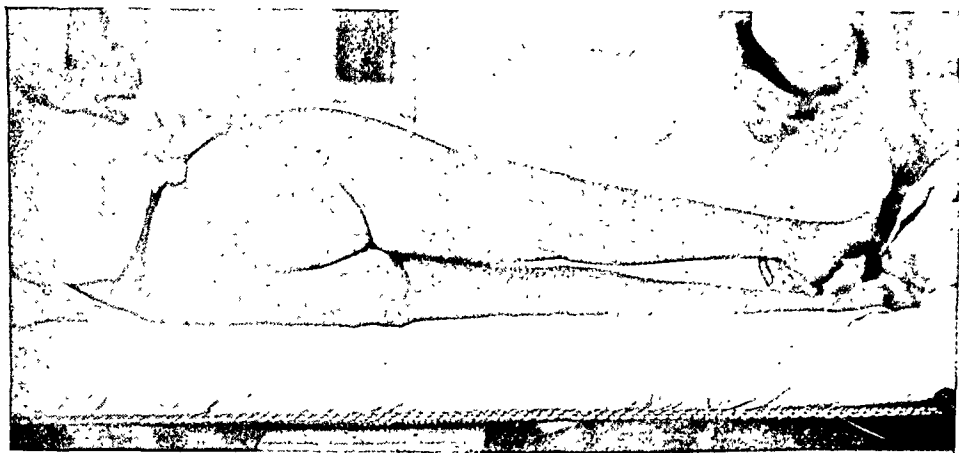


FIG. 3.



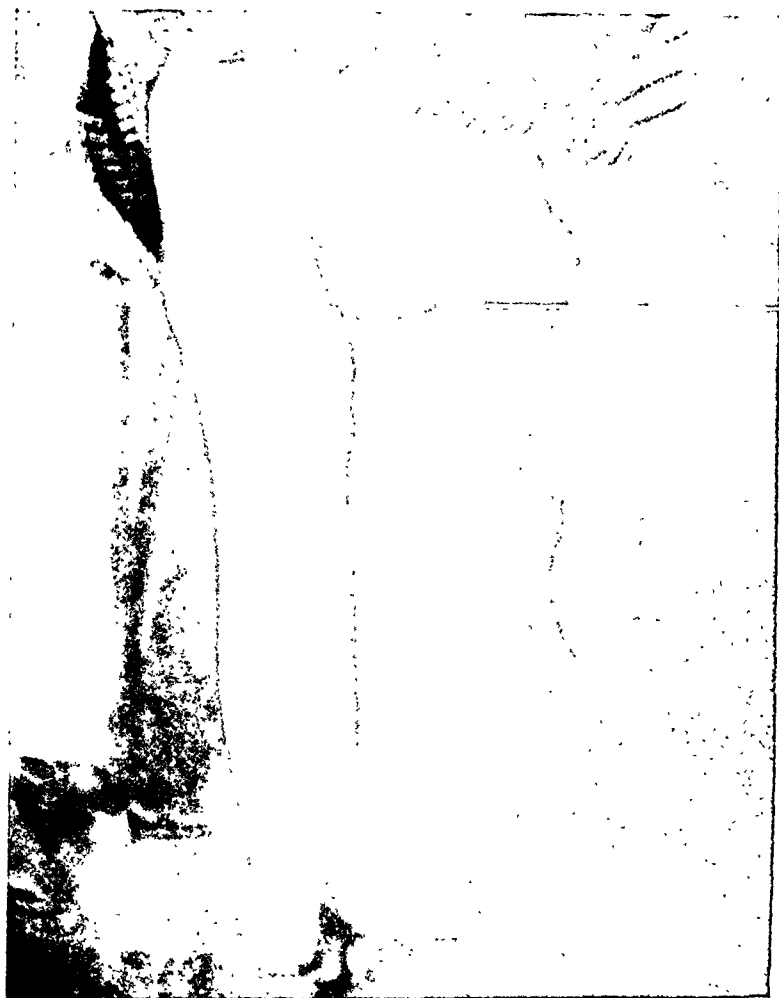
Everted dorsal (supracotyloid) dislocation of right hip.

FIG. 4.



Everted dorsal (supracotyloid) dislocation of right hip. (Photograph taken with patient lying on bed, because of her nervousness after the anterior view was taken by photographer.)

FIG. 5.



Sinus where  
drainagetube  
had been  
placed.

Posterior view after operation of excision of head of femur for everted dorsal (supracotyloid) dislocation of right hip. About three weeks after operation.

FIG. 6.



Showing ability to flex hip in sitting posture after excision of head of femur for everted dorsal (supracotyloid) dislocation of right hip. Taken about three weeks after operation. Knee is still somewhat stiff because of long previous retention of patient in bed, previous to the dislocation.

logical findings. Two weeks before I saw her the attending surgeon had the patient etherized and made passive movements of the hip. The thigh was flexed at a right angle and the limb then abducted and adducted to break up adhesions at the joint. The head of the bone moved under these manipulations. It gave the operator the impression that it became luxated and was replaced, and would not remain in the socket. I understood that he thought it possible that there had been originally a fracture of the rim of the acetabulum, because that cavity seemed to permit the femoral head to slip out and in very readily. After these manipulations the leg measured in length about two inches less than the left limb. The patient was returned to bed and continuous traction with weights applied.

After making the diagnosis of probable old fracture of the neck of the femur, I renewed my efforts to obtain a personal view of a skiagraph taken before she came under my care and to have several skiagraphs taken in the laboratory of the hospital.

After a series of delays both objects were attained. The first skiagraph showed the existence of an arthritis of the hip-joint, which had not been reported to the surgeon in charge, though the adhesions found under anæsthesia had revealed such a condition to him. The second skiagraph, which was made after I had been given charge of the woman, revealed a posterior dislocation of the head of the femur, with eversion of the limb. The head of the femur was seen lying against the ilium, higher than the acetabulum and a little behind it.

In other words, the patient had had a coxitis in January, 1910, followed by articular ankylosis. This had been the cause of her pain, her unwillingness to move, and her nervous perturbation. The manipulations made by my predecessor had ruptured the adhesions, and then a reversed or everted dorsal dislocation had occurred. A more intimate knowledge of the previous history of the patient, obtained during her stay in the hospital, disclosed the fact that there had existed a vaginal discharge just previous to the attack of so-called rheumatism of the hip. Whether the arthritis of the hip was traumatic or infectious is unknown.

In order to reach an operative conclusion, which would give the patient the best use of the injured limb, I called into con-

sultation Dr. James H. Hutchinson, Dr. J. Torrance Rugh, a surgeon and the orthopædist respectively of the hospital, and Dr. Oscar H. Allis, who has made such a valuable study of dislocations of the hip.

The question submitted was whether attempts should be made to reduce the luxation rather than excise at once the head of the femur and thus establish a movable hip-joint.

The acetabulum after the lapse of about five weeks was presumably well clogged with remains of capsule and with inflammatory exudate. It was known to have been an abnormal joint before the luxation took place. The attempts at reducing the displacement by my predecessor were apparently successful, but he was unable to keep the head in the socket, and suspected that the acetabular rim had been broken off. If a stiff hip occurred after a successful replacement, the patient would lose either the ability to flex the hip, as in sitting, or the power to straighten it, as in standing. The joint would be fixed in a position favorable for only one posture, and the patient would be unable to assume the other. My own feeling at first was that reduction should be attempted; but after hearing the opinion of my associates, and considering the history, I decided that it would be wiser to excise the head of the femur and establish a movable joint.

On November 29, 1910, therefore, I made a long incision behind the great trochanter and found the head lying on the ilium considerably above and a short distance behind the acetabulum. It rested in a socket-like depression caused by the normal concavity of the bone at that site being deepened by inflammatory thickening of the surrounding soft tissues. The acetabulum was readily identified. It was situated about  $1\frac{1}{2}$  inches below and a little in front of the resting place of the femoral head. It was filled with soft structures through which the socket could be felt with the finger-tip. The head of the femur was removed by dividing the neck close to it and the wound closed with sutures, after a drainage tube had been introduced. A gypsum encasement including the pelvis, hip, and thigh was applied, with the limb extended and slightly everted. Traction on the leg was made by Buck's method with about twenty pounds attached to the stirrup. An opening was left in the gypsum splint for dressing the wound.

The drainage tube was removed early, the canal left by its

withdrawal loosely packed with gauze, and the encasement removed permanently in less than three weeks. Massage and passive motions of the knee and hip were ordered on the twenty-second day; the patient got out of bed on the twenty-fourth day, and was directed to sit up in a chair, and gradually increase the flexion of the hip.

She continued to be very much afraid to use the limb or try to walk, and said that she had not been out of bed for a year; but at the end of a month she was walking a little on crutches, and the knee, though still stiff from long disuse, was gaining normal mobility under manipulation. The wound had healed promptly except that a sinus existed at the point where the drainage tube was employed. Flexion and rotation of the hip were quite good.

She was ordered to wear a shoe with a high heel and sole, and as rapidly as possible to dispense with crutches or cane. She was unwilling to obtain the shoe before leaving the hospital. Since she went home I have not seen her. A letter recently received shows that she has not obeyed orders in regard to using the limb actively. I, therefore, fear that she will not obtain as satisfactory a hip-joint as she otherwise would.

This case is reported because of the infrequency of reversed or everted dorsal dislocations of the femur, and because my ignorance of the condition led me to believe at first that I had an old fracture of the neck of the bone before me. It is a good illustration also of the value of X-ray pictures. These should always be studied by the surgeon himself, with, however, the aid of an experienced radiologist. I find it of the greatest importance to see and study the plates myself. Errors are likely to be made if the surgeon merely reads the report of the person who made the skiagraphic picture.

In the instance before us the verbal report made to me by the resident surgeon of the hospital was that the first skiagraph showed a normal joint. This was found to be an erroneous statement, because inspection of the plate revealed arthritic changes. I have long regretted that I am not a skilled microscopist and a practical radiologist, in order to more properly gauge the value of my clinical diagnoses.

In 1892 Dr. L. A. Stimson reported to this association an interesting case of upward luxation of the hip which this case of mine resembles; and in the Transactions of 1900 is given the account of Dr. Oscar H. Allis's valuable demonstrations of dislocations of the hip, made before the Fellows at the meeting of that year. Ridlon has reported a supracotyloid dislocation, and adds a valuable bibliography. He gives what I think is a valuable hint. It is that the steady pelvis, necessary when reducing luxations of the hip, may be obtained by flexing the uninjured thigh strongly against the trunk of the patient and strapping it there. The operator's assistants then have a grasp and a leverage by which the pelvis can be held practically immovable during such manipulations as may be required without fastening the patient to the floor with apparatus.

It is now believed generally, I think, that leverage during flexion of the hip is the usual mechanism of luxations of the head of the femur. The femoral head probably escapes always downward by bursting the joint capsule, by means of pressure against its internal surface. Displacements then occur in various directions from the continuance of the accidental forces or as a result of incidental forces. The head of the bone may finally come to rest at any point around the socket. The capsule may be torn from the edge of the acetabulum, from the upper end of the femur, or between these two points. There are two usual positions on the anterior plane of the pelvis and two on the posterior plane, which have received the names thyroid and pubic, and iliac and sciatic respectively. Greater laceration of the capsule, especially of its iliofemoral reinforcement, termed the inverted Y ligament, permits wider excursion of the head under displacing factors. As a consequence various modifications of the posterior and anterior dislocations may occur. Their names are numerous, but the necessity of specific nomenclature is not very apparent.

The capsule is not infrequently crowded into the acetabulum by the advancing head of the femur during attempts at reduction. This is most likely to occur when the course of



the head in its exit from the socket is not retraced by it, when the surgeon essays replacement.

The reversed dorsal luxation, seen in these photographs and skiagraphs, is simply a modification of the ordinary high dorsal displacement permitted, it is believed, by inclusion of the external limb of the iliofemoral ligament in the capsular rupture. It is said by Koenig to occur in breaking away of the posterior wall of the acetabulum. It is more or less equivalent to the so-called "supracotyloid" or "subspinous" form. It is not unlikely that "supraspinous" is employed for a modification of the same form of displacement, for it is described as having the head resting on the ilium much in advance of its usual luxated position and lying above the anterior inferior spinous process or even in front of it, so that the neck of the bone rests against the notch between the anterior superior and anterior inferior process.

In the ordinary dorsal luxation, usually termed the iliac dislocation, the head of the thigh bone lies much behind and above the socket. Because of the tension of the untorn outer branch of the iliofemoral ligament, the limb is inverted. The hip-joint is flexed. When the external limb of the ligament is torn, however, the head of the bone is free to move forward under appropriate forces. Then it approaches the region above the acetabulum and the anterior inferior spine of the ilium, and becomes a reversed or everted dorsal, a supracotyloid or a subspinous. Perhaps the so-called "supraspinous" may be a mere variation.

In reviewing this case I have criticized myself for not removing the whole length of the neck of the femur when I excised the head. I have wondered whether a better use of the limb would have been obtainable by scooping the soft tissues out of the socket, turning in a flap of fascia, and then reducing the luxated head instead of excising it.

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# THE TREATMENT OF OBLIQUE FRACTURES OF THE TIBIA AND OTHER BONES BY MEANS OF EXTERNAL CLAMPS INSERTED THROUGH SMALL OPENINGS IN THE SKIN.\*

BY LEONARD FREEMAN, M.D.,

OF DENVER, COLORADO,

Professor of Surgery in the Medical Department of the University of Colorado.

MANY unsatisfactory results are obtained in oblique fractures of the tibia. As soon as the injured muscles regain their contractility, the fragments frequently begin to slide by each other with exasperating persistency, in spite of the most ingenious splints; and all efforts to prevent shortening and deformity are too often futile after secondary contractures of the tissues occur. Even when the functional result is sufficiently good, the surgeon is still in legal danger, as I have seen in several instances, because a radiograph obtained by the patient can show such poor coaptation that a suit for damages may be instigated.

The methods usually employed in the treatment of these oblique fractures are:

1. *Splints or plaster casts.* These are often powerless to hold the fragments in place without undue tightness or injurious and painful pressure upon the bony prominences of knee or ankle. In addition, they do not exert traction; and without this there can be no certainty that the fragments are held in alignment, owing to the thickness of the tissues, which is usually increased by swelling.

2. *Extension.* In this situation extension is difficult to apply in sufficient amount without discomfort to the patient. Even sloughing of the skin, injurious stretching of the ligaments of the knee, or damage to the nerves or vessels may

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\* Read before the American Surgical Association, June 19, 1911

result, to say nothing of the irksomeness of having to lie continuously in one position for several weeks.<sup>1</sup>

3. *Open operation.* The difficulty can undoubtedly be remedied in this way, but at the expense of some risk. Such procedures usually mean a large wound together with considerable manipulation of the tissues and stripping up of the periosteum. Hemorrhage is at times hard to control, and fragments may have to be removed which could otherwise be left in place. All this gives rise to two dangers—infection and delayed or non-union.

The chance of infection is perhaps not great with a competent surgeon and favorable surroundings; but in the hands of inexperienced operators, under whose care fractures most often fall, the danger is considerable.

The tibia is one of the most frequent sites of delayed or non-union, and particularly is this true of fractures which have been operated upon and perhaps united by wires or bone plates. Fritz König asserts that this is due to the removal of blood-clots and tissue fragments, which are supposed to stimulate bony union, while others place the blame upon the foreign bodies introduced by the surgeon; but whatever the explanation may be, the fact remains.

In addition, even if there were no real objections to an extensive open operation, there would still remain many patients who would refuse to have it done and numbers of physicians whose experience and prejudices would not permit them to do it.

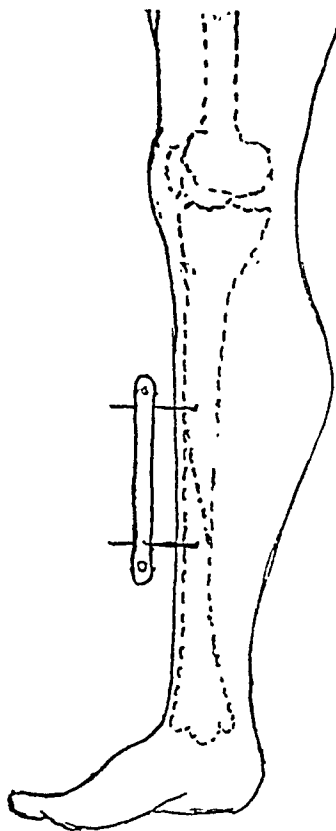
Hence it is desirable that there should be some easy and effective method of handling these oblique tibial fractures, which is not open to the criticisms mentioned above. With this idea in view, it occurred to me that all the requirements could be met, in many instances, by inserting a screw with a long projecting end through a small hole in the skin into the upper fragment, well above the fracture, and another into the

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<sup>1</sup> Steinmann has recently applied his "nail-extension" to this form of fracture, which is, perhaps, an improvement over older procedures, although inferior, I believe, to the method to be described.

lower fragment; then reducing the fracture by manual extension and fastening the screws together by a firm external clamp (Fig. 1 and Fig. 2, *a*, *b*). After testing the method, I made brief mention of it in a discussion on the operative treatment of fractures in the Surgical Section of the American Medical Association, June, 1908.

FIG. 1.



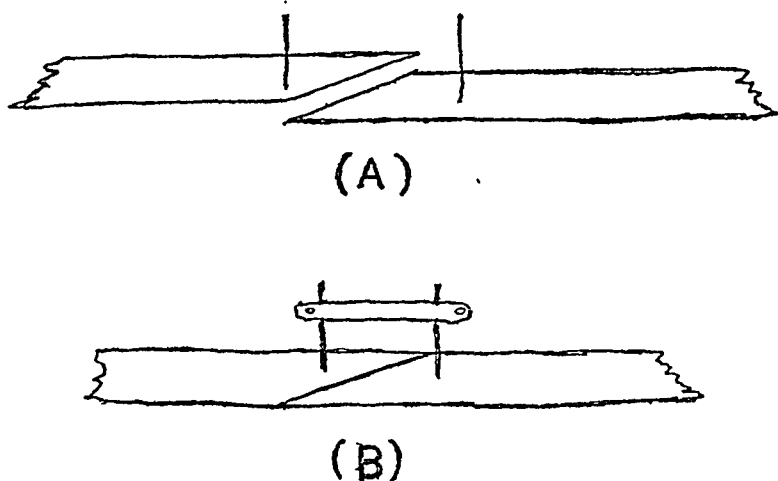
External clamp in position in oblique fracture of the tibia.

*Operative Technic.*—The shape of the fragments and their relation to each other are determined by manipulation and especially by the use of the X-ray. Under general anæsthesia two small incisions, each about one-fourth of an inch in length, are made through the skin and fascia over the flat anterior surface of the tibia, one below and one above the fracture. They should be situated well away from the break,—if possible, in sound, unlacerated tissues.

Through these incisions, holes must now be bored in the

bone for the reception of the screws. This, of course, can easily be done with ordinary drills; but unless some special apparatus is employed, such as I shall describe, the soft parts will close over and conceal the openings in the bone as soon as the drill is removed, thus preventing the insertion of the screw. Every surgeon who has done much bone work has doubtless been annoyed by similar occurrences. To prevent this I employ a small steel tube (Fig. 3, *a*) about the size of a lead pencil, having several sharp teeth at one end, which may be driven into the bone by a tap with some heavy instru-

FIG. 2.



(A), screws in place before reduction of fracture; (B), fracture reduced and screws clamped.

ment. An obturator (Fig. 3, *b*) guards the teeth and facilitates the forcing of the tube through the tissues by means of its pointed extremity.

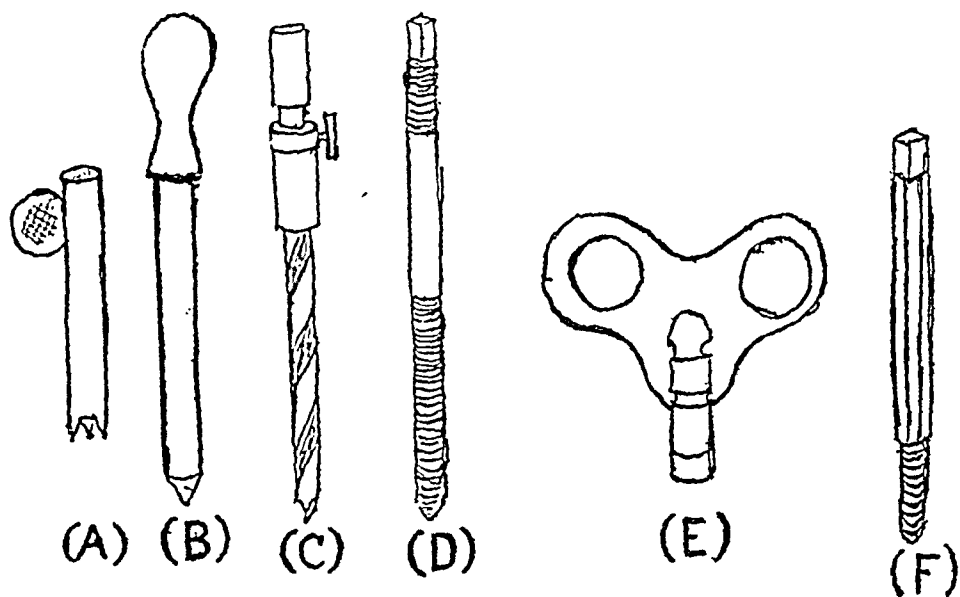
When the tube is set firmly against the bone, an assistant holds it in place by grasping with a pair of forceps the lateral projection provided for the purpose. The obturator is then removed, and a drill inserted in its place, which is fashioned with an adjustable shoulder to fit the tube (Fig. 3, *c*), in order to centralize the hole in the bone and facilitate the entrance of the screw.

The hole must be deep enough to permit the screw to hold firmly, and its lower end should be slightly inclined away from

the fracture in order to give a secure purchase to the clamp against the contraction of the tissues. It should extend through the cortex, at least, and sometimes even through the medullary cavity into the cortex of the opposite side, especially when the osseous structure is unusually soft.

When the drill is removed, a screw which fits the tube (Fig. 3, *d*) is easily inserted and the tube withdrawn. The screw should be long enough to project some two inches above the

FIG. 3.



Instruments required for applying clamp-screws. A, canula; B, trocar; C, drill; D and F, screws; E, key to manipulate screws.

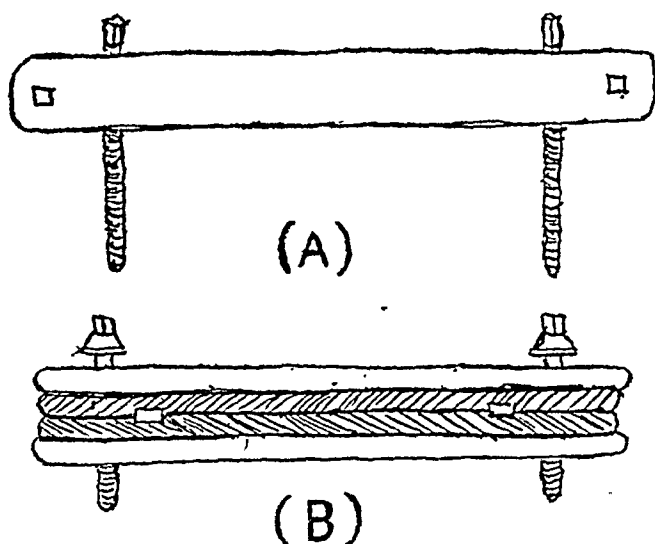
skin after it is driven home. *It must be slightly larger than the drill hole*, to insure solidity, and somewhat pointed at its extremity, so as to enter easily. Its outer end is squared to fit an ordinary clock-key (Fig. 3, *e*), by means of which it is manipulated. The threads are continued up to this squared extremity, thus giving a better grip to the clamp.

The question might here be raised, why the drills could not be left in place instead of taking the trouble to remove them and insert screws? But this is not practicable, because the drills are smooth and smaller than the holes and hence would be lacking in firmness. Practically the same thing can be said

of nails, which, in addition, as they are driven into the fragments may split them and ruin the chances of success.

Forcible manual extension is now applied to the leg until the fragments are brought into position, when the projecting screws are clamped together (Fig. 2, *a* and *b*), thus preventing recurrence of the deformity. The clamp used for this purpose is made of two long, firm strips of steel, held together at their ends by screws, which can be tightened and loosened with a

FIG. 4.



Side and top views of clamp, showing, in (B), the wood lining between the steel side strips.

clock-key (Fig. 3, *e*). A most important feature is that these metal side pieces are lined with soft pine wood, into which the threads of the screws bite as firmly as if the screws were driven through a solid block, thus preventing the possibility of their easily working loose (Fig. 4, *a* and *b*). A dressing is now applied, using thick pads of sterile gauze around the clamp, and the leg is securely but not too tightly splinted.

It will, of course, be understood that the sole object of the clamp is to prevent the ends of the bones from sliding past each other, which is the main difficulty in oblique fractures, and the one hardest to overcome. Angular deformity and lateral separation of the fragments must be controlled by splints, which should be carefully adjusted to the sides of the



limb as well as posteriorly. The use of splints could undoubtedly be rendered less necessary by placing two screws in line in each fragment, as is done in open operations with external clamps, but I am convinced that this is usually unnecessary and merely complicates the procedure.<sup>2</sup>

It is evident that the method just described is not applicable to all cases of oblique fracture of the tibia, but only to those sufficiently near the centre of the shaft to leave room enough on either side for the firm insertion of the screws. It is also not indicated where other and simpler methods will suffice or when the fracture is too old to permit of reduction of the fragments. Its usefulness might also be questioned in compound fractures with openings already so large that wiring could easily be done.

The statement is frequently made that external bone clamps are apt to lead to serious infection. I am convinced that this is not true, not only from my own experience, but from that of Parkhill and many others, and I wish to emphasize the following statement: *If the operation is a clean one, serious infection will not occur. On the other hand, if the operation is not clean, suppuration will take place with any method, but the results will be less serious in the presence of the drainage afforded by the screws of an external clamp; and, furthermore, in case of infection these screws can much more easily be removed than can buried plates, ferrules, or wires—with far less inconvenience to the patient and without the use of an anæsthetic.* To this may be added, that properly applied

<sup>2</sup> The external fixation of bones by means of long screws and clamps was first introduced, as far as I am aware, by Keetley, of London. Since then many different clamps have been devised, including that of Clayton Parkhill, who did more to popularize the method than any other surgeon. Parkhill's clamp, and others which have appeared abroad, are unnecessarily complicated and difficult of application, owing to the various wings, nuts, and adjustments with which they are hampered. The apparatus described above is free from these objections and is so simple that it can always rapidly and easily be inserted. I first described it in the *ANNALS OF SURGERY*, vol. ii, p. 561, 1904.

The various forms of these clamps may be obtained from W. H. Lauth, Metropolitan Building, Denver, Col.

external clamps hold the bones more firmly than do wires or even ferrules or bone plates, and that when they are removed the danger of future complications is done away with completely.

It is, of course, always possible that slight infection may ultimately occur from the screws, although much can be done to avoid this by the occasional application of tincture of iodine to the surrounding skin; but if this should take place, it is of slight importance and does not spread, because the screws, like silkworm sutures, soon become walled off by a resisting cylinder of granulations, as do the nails in Steinmann's method of direct extension. And it should also be clearly understood that the danger of infection is especially slight in the procedure under consideration, in which the screws are inserted at a distance from the fracture, perhaps in normal tissues, through small openings in the skin.

It might be thought that such a large external clamp would cause discomfort; but it must be remembered that the greater part of the clamp is external, and that the portion within the tissues is limited to two moderate-sized screws, which are but little more bulky than a length of heavy wire and much less so than plates or ferrules. And, in addition, experience has taught me that no suffering is experienced by the patient, as is also the case in Steinmann's method of treatment of fractures of the femur, in which heavy weights are suspended from nails driven into the femoral condyles.

The method I have described need not be confined to injuries of the tibia, but may be employed with slight modifications to appropriate fractures of other bones, which are not too deeply situated and which possess sufficient stability to permit of the firm insertion of screws—such as the clavicle, the patella, the upper part of the ulna, the lower jaw, and, under some circumstances, the humerus and even the femur.

It is well known that certain oblique fractures of the clavicle and of the inferior maxilla are extremely hard to hold in position, while open operations for their relief are objectionable, for cosmetic and other reasons. Many more

or less ineffective forms of apparatus have been suggested in their treatment, which, especially in the case of the jaw, often give rise to considerable discomfort, not to say suffering. There is no reason why these injuries cannot be effectually and comfortably handled by an external clamp inserted through such small openings in the skin that but trivial scars will result, it being only necessary to prevent the fragments from sliding past each other in order to achieve success, as I have demonstrated in connection with the jaw. The drills for this purpose, however, must be provided with an adjustable shoulder and the screws with a permanent shoulder (Fig. 3, *c* and *f*) in order to prevent accidental perforation of the bone and injury to the subjacent structures. The tube through which the drill is inserted will prevent lateral slipping of that instrument. The clamps should also be small and made of some light material, such as aluminum, especially where the inferior maxilla is concerned.

It may also be suggested that screws are preferable to nails in applying extension from the condyles in fractures of the femur, because they retain a firmer seat in the bone and are not so apt to become rapidly loose. It is evident that they may easily be inserted by the method under discussion.

# ACUTE PNEUMOCOCCUS INFECTIONS OF THE EXTREMITIES.\*

BY CHARLES A. POWERS, M.D.,

OF DENVER, COL.,

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THAT the *Pneumococcus arthritides* are fairly common seems apparent from the perusal of an interesting paper by Nitch (*British Medical Journal*, September 21, 1907), who says: "After a fairly extensive search through literature I have found records of ninety-eight cases (one hundred cases including two of my own) of arthritis, in which the presence of the pneumococcus was definitely proved by bacteriological examination." Mauclore (*Nouveau Traité de Chirurgie*, Le Dentu et Delbet, Paris, 1909, volume vii) says: "*Pneumococcus pyarthroses* are beginning to attract considerable attention. Traumatism preceding chronic arthritis predisposes to the localization of the pneumococcic infection. The pus is thick, creamy, tenacious, greenish-yellow. From the symptomatic point of view there is at first a very acute stage, with œdema and considerably dilated subcutaneous veins. The pain is moderate, the symptoms tend to improve; the condition may become chronic."

The writer is able to ascertain but two instances in which the pneumococcus in pure culture<sup>1</sup> has been recovered from inflammatory affections of the soft parts of the extremities.

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\* Read before the American Surgical Association, June 19, 1911.

<sup>1</sup>The literature on this subject is very meagre. W. Hagen (*Ueber akute chirurgische Infekt. Krankheiten.*, Würzburger Abhdlg. a. d. Gesamt. geb. d. Prakt. Med., x, 1910) says that the pneumococcus or *Diplococcus lanceolatus* is closely related to the streptococci, and that it may cause a series of pathological processes of the most variegated character, in addition to pneumonia. Secondary inflammations in any tissue or tissues may develop as a sequel of pneumonia through metastasis, but these inflammations may also occur primarily, as the pneumococci are able to enter the organism in other ways than by way of the lungs. They have been found in the accessory sinuses of the nose, the tympanic cavity of the ear, etc. Their cultural behavior resembles that of streptococci, from which they are sometimes distinguished with difficulty.

The first of these is reported by SABATIER (Contribution a l'étude des localizations extrapulmonaires primitives du pneumocoque, *Archiv. Gén. de Médecine*, No. 30, 1906). It concerns the case of a young soldier, who was kicked by a horse in the middle third of the antero-external region of the left leg. No bone was broken. The condition seemed to be that of a simple contusion. Four and a half months later a phlegmonous inflammation of the leg developed. An abscess was incised, and a thick, dark greenish pus evacuated. The centre of the purulent focus seemed to lie in the subcutaneous cellular tissue between the skin and the muscular aponeurosis. Examination of the pus showed the presence, in large quantities, of the *Pneumococcus lanceolatus*. Slow healing.

The second observation was made by T. ARNOLD JOHNSTON (A Case of Pneumococcal Infection, *British Medical Journal*, October 12, 1907). He pricked the third finger of his left hand while resecting a child's rib for pneumococcal empyema. There was an inflammation of the cellular tissue of the finger and hand, the condition being ushered in by a chill and vomiting. There was a continuous high fever for several days, crisis on the fifth day, with profuse perspiration and immediate cessation of all grave symptoms. Various incisions were made, but no pus was found. The serum from the wounds contained pneumococci in pure culture. Johnston says: "The course of the disease bore a remarkable resemblance to the typical course of croupous pneumonia, and is perhaps suggestive of a different line of treatment for similar general infections, abandoning surgical procedures." The incisions certainly relieved tension by bleeding freely, but no pus formed, and the resulting cicatrization has produced considerable stiffness and tenderness which is yielding slowly to massage. In a similar case I should be inclined to examine the serum for pneumococci, and, if this were found, treat the case as an ordinary pneumonia,<sup>2</sup> giving morphine in small doses for the pain."

In close connection with this case of Johnston's the writer would cite the following personal observation:

CASE I.—Mr. X., a machinist, twenty-six years of age, injured the last phalanx of his left thumb on March 29, 1911, sustaining a contused and lacerated wound of moderate extent. He was immediately accorded suitable aseptic care. Infection slowly developed, spreading up the forearm and arm in the form of a superficial lymphangitis. Through the courtesy of Dr. L. T. Durbin he was seen by the writer on April 6. At this time the thumb was suppurating moderately, the hand was somewhat swollen, there was a superficial lymphangitis on the anterior aspect of the forearm and arm. There was a tender mass the size

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<sup>2</sup> The writer is unable to agree with this suggestion.

of a small apple in the axilla. The pulse was 80 to the minute, the temperature  $100.6^{\circ}$ . The patient did not complain of feeling definitely ill. The moist boric compresses which had been instituted by the attending physician were continued. Eighteen hours later the patient had a severe chill, the pulse went to 108 to the minute, the temperature to  $102^{\circ}$ . When the limb was examined it was found that the inflammatory process had extended to the deeper tissues, the whole extremity being much swollen and reddened, painful and tender. The patient felt correspondingly ill and depressed. The entire picture was that of a rapidly extending septic infection.

Operation under ether, April 7. Multiple free incisions through the deep fascia from the thumb and hand to the shoulder. No pus found. The tissues were boggy and œdematous. Cultures taken from the deep tissues of the arm just below the shoulder were submitted to Dr. E. C. Hill for examination. Dr. Hill reported, after very careful examination, that he found pure cultures of pneumococcus.

After the incisions were made the process rapidly subsided. The following day the temperature was  $99.4^{\circ}$ , the pulse 90. The axillary enlargement rapidly disappeared. The wounds made in the forearm and arm healed without suppuration, the thumb suppurating moderately. Cultures taken April 12 showed pneumococcus and staphylococcus, the latter doubtless due to accidental infection. The case went on to a relatively early recovery.

While this process resembled a streptococcic one, it seemed to the writer less virulent than one observes in the ordinary diffuse streptococcic infections, and it subsided rather more rapidly than does a streptococcic process of similar extent.

A second observation concerned a young gentleman serving at the time as a surgical interne at St. Joseph's Hospital in Denver. In February, 1911, he developed a small furuncle at the back of the left hand, apparently originating in a hair follicle. The hand became moderately swollen and was tender. Incision revealed a little pus and from this the pneumococcus in pure culture was recovered. Three or four other small furuncles followed, each showing the pneumococcus. Clinically the process did not seem to differ materially from that seen in an ordinary staphylococcus furunculosis.

# DISLOCATION OF THE HIP COMPLICATED WITH FRACTURE OF THE FEMUR.

REPORT OF TWO CASES.

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OF BOSTON, MASS.,

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IF one may judge from the few cases of dislocation of the hip with fracture of the femur that are reported, it is fair to assume that this combination of injuries is a very rare one. It is for this reason that I venture to place on record the two cases referred to in the title of this paper. These cases were admitted to my service at the Boston City Hospital; one at the main hospital, and the other at the relief station in Haymarket Square. Both of them I personally examined and treated.

I will give all the facts I have been able to get in regard to these cases, but, unfortunately, in neither of them is the information gained very full or exact.

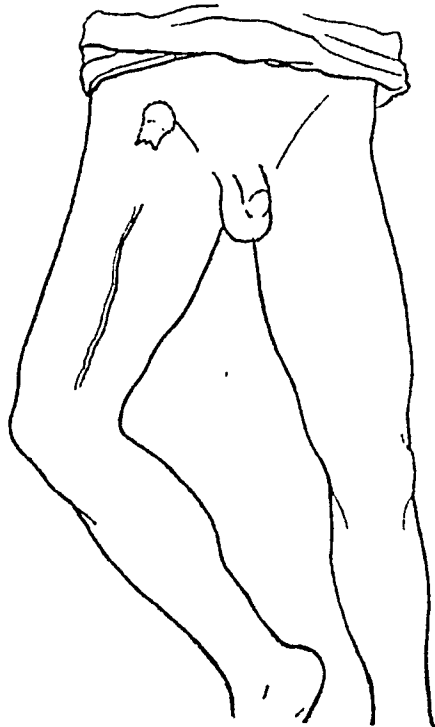
*CASE I.—Anterior dislocation ("pubic") of the head of the right femur, complicated with fracture through the neck of the bone; other injuries; reduction of dislocation; death a few hours later.*

W. F. C., a man of sixty-four years, was run into by an electric car, Feb. 24, 1909, receiving a number of severe injuries, from the effects of which he died about seven hours later. Immediately after the accident he was brought to the hospital, and there carefully examined by the house surgeon, who forthwith notified me. I went to the hospital at once, and made an examination as thorough as the conditions allowed. The man was in a state of shock so severe as to suggest the presence of internal injuries and to admit of little prospect of his recovery. There was a fracture of the right clavicle, and also of the fourth, fifth, and sixth ribs, over the region of the heart. Besides this, there had evidently been much damage done in the neighborhood of the right hip.

Upon examination of the hip and the region about it, the

following conditions were apparent: There was a *fracture* through the neck of the femur, and the head of the bone was *dislocated anteriorly*, lying at a point near the middle of Poupart's ligament. The head lay in such a position that its fractured surface faced downward and slightly forward. Across this jagged bony surface lay the femoral artery, which beat freely. The superficial veins of the entire leg were enlarged and very prom-

FIG. 1.



Sketch showing the relative position of the two legs in Case I, as the patient lay upon the floor. Anterior dislocation ("pubic") of the head of the right femur, complicated with fracture through the neck and with pressure upon the femoral vessels. The position of the displaced head of the bone and of the enlarged and prominent internal saphenous vein is roughly indicated in the sketch.

inent—a condition which suggested probable obstruction to the femoral vein. The leg was everted, and the knee slightly bent. Fig. 1, being a copy of a sketch I made at the time—as the patient lay upon the floor before he was etherized—gives a general idea of the position of the leg and of the detached head of the bone.

Realizing that the fractured end of the femoral neck would, if allowed to remain in this position, ultimately open up the vein or the artery (if it had not already done so), I decided to make the attempt at once to reduce the dislocation, and, in the



event that I should fail, to cut down upon the dislocated head. Ether was given, and then, in accordance with the advice given by Allis, steady traction was made on the limb by an assistant, while I attempted to manipulate the head of the bone back into the joint. This I succeeded in doing, but only after a prolonged trial, during which the leg was placed in a variety of positions.

*Remarks.*—Judging from palpation of the dislocated head, and also from the fact that it lay in its displaced position far from the end of the bone to which it belonged, I am inclined to think that the fracture was an intracapsular one, and that the head had entirely broken away from all vascular connection with the tissues.

The fatal termination of this case a few hours later made me think that, possibly, I ought to have waited for the patient to recover from his first shock before undertaking reduction of the dislocated fragment or its resection; but, as I now think over the case, I believe that I was right in doing as I did, for the reason that the danger of perforation of the femoral artery or vein was imminent. Unfortunately, no autopsy was made in this case, and therefore the existence of severe internal injury, which the symptoms suggested, could not be proved.

CASE II.—*Anterior dislocation ("low thyroid?") of the head of the femur; reduction; fracture of great trochanter and of the acetabulum (?) discovered during convalescence by Röntgen examination.*

J. J. K., hoisting engineer, sixty years old, was brought to the relief station in Haymarket Square, March 29, 1911.

The patient stated that he was struck by an electric car, and that, having fallen under the fender, he was pushed along for a short distance, during which time he thinks he was lying on his right side. He could give no further particulars.

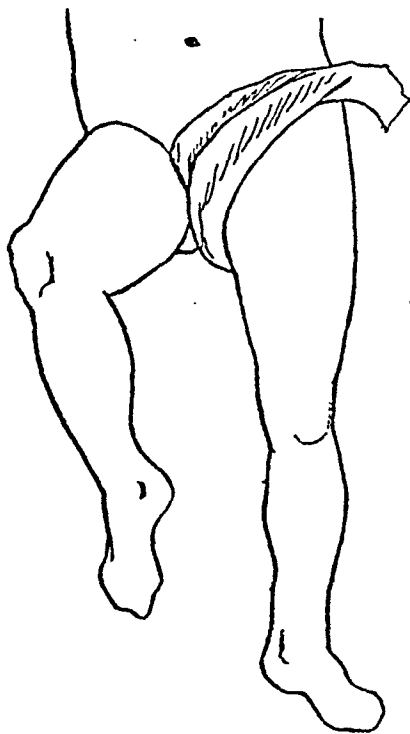
The man was powerfully developed and rather stout. There was an alcoholic odor to his breath, his speech was thick, and his cerebration slow. There were numerous abrasions over his right arm and right leg.

As it was evident that the case was one of dislocation of the hip, the man was laid upon the floor and profoundly etherized

before a thorough examination was made. As he lay there I made a rough sketch of his legs, showing their relative position. Of this sketch Fig. 2 is a copy.

The right thigh was flexed at an angle of about  $45^{\circ}$  and somewhat abducted. The foot was strongly everted, and its outer border rested on the floor. The region corresponding to Scarpa's triangle, at the inner aspect of the upper part of the thigh, was

FIG. 2.



Sketch showing the relative position of the two legs in Case II, as the patient lay upon the floor. Anterior dislocation ("low thyroid") of the head of the right femur complicated with fracture.

bulging, and, near the middle of Poupart's ligament, could be felt on palpation a rounded mass which was evidently the head of the femur. In the region, where ordinarily the great trochanter can be felt, there was a deep sulcus. By rectal palpation could be felt a smooth rounded body—evidently the head of the femur—which, when the thigh was flexed and rotated, could be felt to move. Apparently the head lay in front of the thyroid foramen.

On first attempting to reduce this dislocation by the Bigelow method (external circumduction, flexion, and vertical trac-

FIG. 3.



Showing a print (with key) of the Röntgen plate of the right hip (seen from behind) in Case II. The two small fragments of bone referred to in the text are to be seen (indicated by arrows in the key) just above the neck of the femur. Careful examination also reveals what may be gaps in the great trochanter and in the brim of the acetabulum.

KEY TO FIG. 3.





tion) the head of the bone slipped past the rent in the capsule, and slid into a pocket on the dorsum ilii. I made careful inquiry as to whether the head of the femur was originally dislocated upon the dorsum, and whether it had been carried forward into an anterior position by efforts to reduce it; but I received positive assurance that the dislocation was the same when I saw it as it was when the man was brought to the hospital.

I made further efforts to reduce the dislocation, but I succeeded only in transforming a posterior dislocation into an anterior one again, and then an anterior into a posterior, and so on for several times. Finally, after causing the head of the bone to be brought to the position where I thought the rent in the capsule should be, and pressing on the great trochanter, I succeeded in reducing the dislocation without difficulty.

Pads were placed between the patient's knees and also between his ankles, and the two legs at these points were loosely bandaged together.

The man was later transferred to the main hospital, and a Röntgen examination of the region of the injured hip was kindly made by Dr. A. W. George (see Fig. 3).

The Röntgen plate showed two small, more or less detached fragments of bone, just above the neck of the femur. Where these fragments came from is not at all clear, although the plate indicates that they were originally a part either of the great trochanter or of the brim of the acetabulum, or of both of these structures. This element of fracture introduced into the case a complication, which up to that time had not even been suspected.

The man left the hospital about the middle of May, his improvement to that date being entirely satisfactory.

*Remarks.*—This case was peculiar in the dislocation as well as in the fracture. That the head was dislocated anteriorly was evident from the fact that not only could it be felt in the region of the groin but also by rectal palpation. If further proof were needed it might be found in the eversion of the foot, the absence of the trochanter from its usual position, etc. In fact, these signs rather go to prove that this dislocation (unless, on account of the fracture complications, it belongs to the irregular class) is an example of dislocation of the hip of the "low thyroid" variety (Allis).

The marked flexion of the thigh in this case strongly suggests a downward dislocation ("luxatio subcotyloidea" of Malgaigne)—in fact, there was much resemblance between the position of my patient's limb as he lay upon the floor and that of the figure in Dr. Bigelow's monograph illustrating this so-called "downward dislocation." But such a dislocation would obviously be impossible in a case in which the head of the femur could be felt in the groin, and which presented the other signs already enumerated.

I am not aware, however, that this marked flexion of the thigh is a characteristic sign of thyroid dislocation, and I think it possible, therefore, that it may have been caused, partly at least, by the great trochanter being caught below the acetabulum.

The ease with which the head dropped into a position on the dorsum ilii during my first manipulations (for I was not using great force at the time) inclines me strongly to the view that the original dislocation was probably a posterior one, which was later changed to anterior. If such were the case, and, assuming that the shifting of the head of the bone was not due to intentional manipulation, I think it possible that it may have been caused by unskilful handling at the time when the man was picked up and brought to the hospital.<sup>1</sup>

The difficulty experienced in reducing this dislocation was due partly to the fact that the man's leg was large and heavy, and therefore difficult to manipulate properly, and also to the ease, already referred to, with which the head of the bone could be displaced from an anterior into a posterior position, and *vice versa*. It is quite possible that the existence of the fracture through the tip of the great trochanter, the existence of which however I did not suspect at the time of the reduction, may have increased the difficulty still further.

I have been able to find in the literature only a few cases of hip dislocation complicated with fracture of the femur.

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<sup>1</sup> For a somewhat similar case, see article by G. Fischer entitled "Umhandlung einer Luxatio publica in eine Luxatio ischiadica," *Deutsche Zeitschr. für Chirurgie*, 1890-91, xxxi, p. 438.

These cases differed considerably as to the variety of the dislocation, and also as to the site of the fracture. In some of them the dislocation was of the posterior variety, and in others of the anterior. The fracture in the large majority of the cases was either through the shaft of the bone or through its neck.

Of those cases where the fracture was *through the neck of the bone* the fracture usually resulted from attempts to reduce the dislocation. In only a few of them did the fracture occur at the same time as the dislocation.

Referring to cases of dislocation combined with fracture of the neck, Stimson,<sup>2</sup> who analyzed 14 cases collected by Wippermann and also those referred to by Hamilton, writes: "The only cases of which I have knowledge in which the neck appears certainly to have been broken at the moment of dislocation are one reported by Tunnecliff and one by Post, in which both hips were dislocated, and one by Lossen, and even in the latter the patient was not seen by the reporter until six weeks after the accident . . . ."

The case reported by Douglass, however (No. 2 in Wippermann's list, but with the wrong reference) bears such a striking resemblance to the first of my cases that I cannot refrain from giving a brief description of it.

A man of sixty was severely injured as a result of a building in which he was working falling upon him. A pubic dislocation with a fracture of the neck of the femur was the result. The man died about 12 years later, and the condition, for which he had during life apparently received no treatment, was found at autopsy to be as follows: The somewhat movable head rested upon the ileopectineal eminence directly under the skin and fascia, the artery and vein being to its outer side. Between the head and the bone, upon which the head rested, was an adventitious bursa. The broken end of the femur had dropped back and was fixed to the edge of the acetabulum by fibrous tissue, allowing some movement.

Flower's case also had certain resemblances to my first case, except that the fracture of the neck occurred while the

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<sup>2</sup> Fractures and Dislocations (1900, p. 755).

attempt was being made to reduce a pubic dislocation. The head was left "under the femoral vessels, so that the femoral artery could be felt pulsating over it. The limb immediately presented a dusky—I might almost say purple—hue from venous congestion, and became cold." The head of the bone was excised and the wound was soon healed.

I can find only two cases (Lauenstein's and Borchard's) of *fracture of the great trochanter associated with dislocation*. The cause of this fracture is not clear, although it is noteworthy that in both of these cases the dislocation was of the suprapubic variety. Lauenstein's patient fell 25 feet down the hold of a vessel, and Borchard's (a boy of fourteen) was run over by a roller drawn by horses. Both patients died, and in each case there was an autopsy.

It is not unlikely that fracture, especially such as does not interfere with the continuity of the bone, is a more frequent complication of hip dislocation than it is commonly supposed to be—a conjecture, the truth of which may perhaps be shown in the future by a careful Röntgen examination of all cases of hip dislocation.

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Harcourt: Buffalo Med. and Surg. Journ., vol. x, 1871, p. 241. (Head.)

Murdock: Trans. of the Med. Soc. of Penn., vol. xii, 1878, p. 144. (Shaft.)

Allis: Trans. of the Med. Soc. of Penn., 1879, vol xii, 11, p. 682. (Three cases of dislocation, each with fracture of the shaft.)

Kammerer: New York Med. Journ., Feb. 16, 1889, p. 175. (Shaft.) (Including numerous references.)

Crile: ANNALS OF SURG., 1891, vol. xiii, p. 373. (Head and acetabulum.)

Mitchell: Trans. Illinois Med. Soc. (Chicago), 1891, xli, p. 251.

Woodruff: Trans. So. Car. Med. Ass'n, Charleston, 1894, xliv, p. 113. (Shaft.)

# TRANSACTIONS

## OF THE

# AMERICAN SURGICAL ASSOCIATION.

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*Annual Meeting held in Denver, Colorado, June 19-21, 1911.*

The President, RICHARD H. HARTE, in the Chair.

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### ADDRESS OF THE PRESIDENT.

#### THE TREATMENT OF FRACTURES OF THE LONG BONES.

The President, Dr. RICHARD H. HARTE, of Philadelphia, delivered the opening address, for which see page 289.

#### EPISPADIAS IN THE FEMALE AND ITS SURGICAL TREATMENT.

Mr. HAROLD J. STILES, of Edinburgh, Scotland, reported two cases of epispadias in the female, in which he had successfully transplanted the ureters into the pelvic colon. He described the nature of the deformity and traced its developmental pathogenesis. The incontinence of urine which resulted dated from birth and was diurnal as well as nocturnal. He recommended a routine examination of the vulva in all children suffering from incontinence of urine; if this were done he believed the condition would be shown to be less rare than was supposed. As regards treatment it was a comparatively simple matter to obtain a satisfactory cosmetic result by restoring the anterior commissure and uniting the two halves of the split clitoris. It was far more important, however, to get rid of the incontinence which resulted from the

imperfect development of the urethra and vesical sphincter. This Mr. Stiles had succeeded in doing by dividing the ureters close to the bladder, ligaturing the distal stump, and then transplanting the proximal ends into the lower part of the pelvic colon by the intraperitoneal route. Mr. Stiles described, in detail, the technic to be employed in order to avoid the two great dangers associated with the operation, viz., leakage and ascending kidney infection. His method consisted in implanting the ureters very obliquely into the bowel by a modification of the Witzel-gastrostomy principle. One ureter was transplanted at a time, three weeks or so being allowed to elapse between the two operations. In the first patient the right ureter was double, but this did not materially complicate the operation. Both patients made an uninterrupted recovery. The operations were done rather more than three years ago. The younger child, now six years old, had no incontinence during the daytime, but she occasionally wetted the bed during the night. The older child, now aged ten years, had no incontinence whatever, and did not have to empty the rectum oftener than every three or four hours. Both children were well, and there was no sign of kidney trouble. Mr. Stiles believed these were the first reported cases of epispadias in the female in which the ureters had been successfully transplanted into the bowel. He was not without hope that by adopting the method of uretera-intestinal implantation he had described as a preliminary step in the treatment of malignant disease at the base of the bladder, surgeons would be able to deal with cases which, up to the present, had been regarded as inoperable. The future of the surgery of malignant disease of the bladder (and possibly also of the uterus) depended on how far we were able to solve the problem of uretero-intestinal anastomosis.

DR. JOHN B. MURPHY, of Chicago, Ill., remarked that epispadias in the female can be divided from a practical stand-point into three groups: the upward splitting of the clitoris; that involving the splitting of the urethra back to but not including the sphincter; that including the sphincter and giving incontinence. The first thing in connection with all cases is to take them very early. He believed that the failure to get good results in these cases is due not to the fact that the sphincter is not there, for it is there in every case, but because a sufficient liberation

of the walls of the bladder and of the base of the urethra is not made, in order to get an approximation of the layers of the urethra, before a condition of retention of urine in the bladder itself is produced. There should be a primary operation on the surface of the bladder and urethra before an attempt is made to close the bladder. In the type of epispadias in the female where the urethra has penetrated the clitoris and appears on the under surface of the symphysis with just a thin web between the urethral lining and the symphysis, an extensive dissection must be made to bring the bladder down and expose its neck for approximation.

DR. HOWARD LILIENTHAL, of New York City, called attention to the method of Guiteras in which, after performing the sphincter work, a small sized rubber catheter is put into each ureter and kept there 'during the time of the healing of the plastic work above, thus obviating the constant flowing of the urine over the operated parts.

DR. CHARLES H. MAYO, of Rochester, Minn., said that several times he had had to remove the bladder for malignancy in the adult. He had brought the ureters out into the back in two of these cases. It seemed to him this method described by Mr. Stiles opens up a wide field for cancer of the prostate and of the base of the bladder involving the trigone.

DR. JAMES E. THOMPSON, of Galveston, Texas, did not think a sufficient time had elapsed since Mr. Stiles operated on the cases he reported to say with any certainty that an infection will not pass up the ureter to the kidneys. He had seen two cases in which the ureters were transplanted into the pelvic colon; one patient did splendidly for three years and a half, was apparently in perfect health, then suddenly fell sick and died in three or four months: the postmortem showed the kidney riddled with abscesses. The other patient lived for about four years and a half, with the same fatal termination.

#### THE OPEN TREATMENT OF FRACTURES.

DR. EDWARD MARTIN, of Philadelphia, Pa., presented a paper in which he discussed the treatment of transverse or nearly transverse fractures of the femoral shaft, the writer holding that thus the discussion might be more profitable, since there can be no

reasonable doubt but that for these fractures the plating method is far superior to all others. He pointed out the difficulty of reducing these fractures, and stated that in his experience he had never been able to overcome a deformity by continued traction with weights and pulleys when he had failed to do it immediately by manipulation and traction under an anæsthetic. It was also shown that by pull on the lateral ligaments and the fibrous septa attached to the inner and outer lip of the linea aspera the backward tilting of the lower fragment was usually produced. Stress was laid upon the importance of being provided with tools proper for an open operation upon this bone, and also upon testing the tools in order to see, for instance, that the drill was of the proper size for the screws. It was shown that the screws vary in size and pitch, and therefore that a number should be provided so that if one turns home hard another can be substituted. The indication for the open operation is failure to produce partial or complete apposition of broken ends. The incision recommended is one to the outer side of the rectus muscle, going through the cruræus and coming at once on to the fracture. The method of reduction is that which can be accomplished with the least stripping of periosteum and soft parts; sometimes an iron hook passed into the medullary cavity of the upper end of the lower fragment suffices, aided by longitudinal traction applied to the ankle, or when the lower fragment is tipped back by this traction, by applying the pull just below the bent knee. When the lower fragment cannot be hooked in position in this way it is advised to angle out the fragments, oppose them, and straighten the leg, thus using powerful leverage on the resisting muscles. When none of these methods are applicable, and this is usually the case in fractures of more than three or four weeks' standing, the middle of a canvas band is placed over the upper end of the lower fragment, to the long ends of this band are fastened from 100 to 200 pound weights, the band is prevented from angling out by direct pressure through gauze pads, and a wait of from five to ten minutes usually accomplishes not only complete reduction but a little lengthening. One-quarter of an inch should be obtained before the traction band is taken off. Sometimes more than 200 pounds pull is required. In old cases where the shortening is so great that it cannot safely be overcome by traction, resection of bone ends is of course indicated. Accurate

apposition very often requires the application of forcible pressure. Instruments were shown by which this could be accomplished; also instruments by means of which the broken ends of the bone are kept in proper position and the plate is held in place while the screw holes are being driven and the screws inserted. Experimental investigations have shown that two screws will hold a plate so firmly that it breaks before tearing loose, that the screws should not be nearer than  $\frac{1}{4}$  inch to the broken ends, and that they need go through only one thickness of the cortex. A further investigation showed that the plates supplied vary greatly in strength, that some of them break under very slight force, usually at the screw hole nearest the fracture. For the purpose of correcting this Dr. Martin has had made by Lentz a vanadium steel plate about three times as strong as the ordinary plate, and further reinforced at the screw holes where breakage is liable to occur. This enables smaller plates to be used without any sacrifice of strength.

In conclusion Dr. Martin expressed himself as thoroughly in favor of operating on these cases under the indications given above. He believed that union was usually delayed and that this delay was proportionate to the amount of stripping of the periosteum and traumatizing of the soft parts. He believed if all the results of the present wave of enthusiasm for this method of treatment were published, it would not be regarded as creditable either to the surgeons or to the method itself. The major difficulty, given a clean operation, was in the matter of non-retention. In the case of other long bones this could probably be absolute; in the case of the femur it was practically never so. The slight recurring motions would inevitably loosen the screws. The best splint is plaster-of-Paris, which should be so cut when soft that the upper portion could be lifted off like a shell. This splint should extend from the foot to the axilla.

#### THE FIXATION OF OBLIQUE FRACTURES OF THE TIBIA BY MEANS OF EXTERNAL BONE CLAMPS.

DR. LEONARD FREEMAN, of Denver, Colorado, read a paper with the above title, for which see page 381.

DR. JOHN B. ROBERTS, of Philadelphia, Pa., strongly criticized the elaborateness of Dr. Martin's tools and their cumbersomeness,

and his proposition to pull down the lower fragment with a weight of 100 pounds or more! Equally good results can be obtained by the ordinary old-fashioned pulleys with Bucks' extension. He agreed with Dr. Freeman that pins such as he described do not as a general rule suppurate, and if suppuration should occur it can readily be controlled.

DR. THOMAS W. HUNTINGTON, of San Francisco, Cal., said that four years ago there were few of the leading surgeons in America who appreciated the merits of the open treatment of fractures sufficiently to discuss it. Now he had found on sending out a circular letter regarding this treatment that 93 per cent. of those to whom he had applied agreed as to the propriety and safety of the operative treatment of recent fractures in the hands of skilled surgeons. In dealing with recent fractures, the rules should be that the least possible foreign material must be placed under the skin. It does not necessarily affect the general question as to the propriety of operative procedure, that surgeons do now and then have to remove a plate, staple, or wire, but the least possible number of removals will tend very largely toward establishing the legitimacy of this undertaking. A point which he thinks of great importance is, that the further away from the skin one can place foreign material, the more the security that it will be retained permanently.

DR. A. T. BRISTOW, of Brooklyn, N. Y., had operated nine times during the past winter by the open method for the treatment of recent fractures, and in every case the results were good. There is one point he thought worthy of attention in the after results. A surgeon operates, the patient becomes infected, the conclusion is that the infection is the result of the operation, failing in almost every instance to take into consideration the possibility of a pathogenic infection, a sore throat, etc. Very often the infection is hæmatogenous in character and not due in any way to the operative procedure.

DR. JOSEPH RANSOHOFF, of Cincinnati, Ohio, did not believe that this open method of treatment should be generalized, for in his judgment it is one of the most dangerous operations in hands not thoroughly competent in everything pertaining to surgical technic. He had had one death himself years ago; knew of another from hemorrhage, and Dr. Martin told of another in his paper. A most important point is the time at which an operation should

be performed. It should be either at the time of fracture or at least within a week thereafter; the longer one waits the longer the deformity exists, shortened muscles and thickened periosteum develop, and the more difficult it becomes to reduce or wire, and the more difficult to keep the shortened muscles in extension. We cannot pull too hard on the femur, for it takes at least from 45 to 65 pounds to overcome the pull of the strong musculature around the thigh.

DR. FRED B. LUND, of Boston, Mass., remarked that one reason why surgeons have not been more in favor of operating on the femur has been because they have not had the proper apparatus. He did not agree with Dr. Roberts that the tools employed by Dr. Martin were too cumbersome. Do not put on two plates where one will hold. The plates are good in fractures in old people and in those who will not wear cumbersome apparatus. He had operated on 12 cases; in two he had to take out the plates on account of suppuration, one three weeks after operation, and one 12 days. Both were cases of fracture of the forearm, which are very difficult to treat on account of the smallness of the bones. In plating the femur, a strong apparatus is required, although the size of the foreign body introduced should be just as small as possible.

DR. ARTHUR DEAN BEVAN, of Chicago, Ill., did not believe at all in the routine employment of the open treatment for fractures, but does believe that this treatment has a very sure place in selected cases in the hands of experienced surgeons. It should be employed only in cases in which experience shows that a good, useful, functional, and clinical result cannot be obtained by less dangerous procedures. It cannot be stated too emphatically, however, that it should be employed only in selected cases, and that the operation should only be performed by men constantly doing surgical work, with every regard for the ordinary and extraordinary precautions as to asepsis, etc.

DR. ALEXANDER PRIMROSE, of Toronto, Canada, said that a class of cases very applicable to this treatment is that of fracture at the upper end of the humerus where deformity is caused by rotation. By the open method it is a simple matter to rotate the arm, fix the plate, and restore the arm to a comfortable position. With regard to the use of the open method in compound



fractures, in an aseptic wound where there is sufficient drainage, the method is of value.

DR. ARPAD G. GERSTER, of New York City, called attention to fractures, generally comminuted, involving the lower end of the humerus, of the T or Y shape, where one or both condyles of the humerus have been broken off in such a fashion that no amount of manipulation or fixation by the older methods will be sufficient to reduce the bones into the normal position, and so retain them. In several such cases he had found the plating of very great value; no disagreeable dressings were necessary; the union was very prompt.

DR. M. L. HARRIS, of Chicago, Ill., had found the use of plates in compound fractures of the leg to be extremely useful. In the severe compound fractures ground full of dirt, in which there is certain to be suppuration, and which are extremely difficult to maintain in apposition by any method of dressing owing to the fact that they must be kept open and drained, he had used plates (knowing they must be removed later) to hold the bones in apposition. This forms a simple, easy fixation dressing with the wound open, thereby materially facilitating the draining of the wound and shortening the period of healing.

DR. STANLEY STILLMAN, of San Francisco, Cal., said that in very heavy individuals the necessity of plating a fracture of the femur is imperative. He used very small and light plates. In fracture of both bones of the forearm, if the bones are put in place there is not much tendency to displacement unless the fracture is very oblique. No man should undertake the open treatment of fractures unless he is a pretty good carpenter. In simple fractures where accurate and absolute apposition has taken place recovery is usually very slow; the amount of callus thrown out is slight; better and quicker healing is obtained where the apposition is not so accurate.

DR. CHARLES A. POWERS, of Denver, Colorado, remarked that there are at this time in all parts of the country a very large number of surgical operators, and he believed that in addition to the further improvement in operative technic there is room for more careful selection of the cases of fracture demanding operation. Surgeons should not lose sight of the established fact that a satisfactory or even perfect functional and cosmetic

result may occur in certain cases in which complete anatomical reposition is lacking.

DR. KENNETH A. J. MACKENZIE, of Portland, Oregon, said that his hospital service was largely an emergency service and he had quite an experience with fractures of the femur. He had been surprised to find in the majority of instances that the adoption of the plaster bandage, first devised by Stimson, had been the means of obtaining remarkably good functional results, even though examination with the X-rays showed the position of the fragments at times to be faulty.

#### EVERTED DORSAL DISLOCATION OF THE HIP: WITH THE REPORT OF A CASE MISTAKEN FOR FRACTURE OF THE FEMORAL NECK.

DR. JOHN B. ROBERTS, of Philadelphia, Pa., read a paper with this title, for which see page 371.

DR. GEORGE W. CRILE, of Cleveland, Ohio, remarked that the principal resistance to the reduction of dislocations, regarded physiologically, is the normal muscular tone and the muscular contractions due to the mechanical stimulation of the muscles in the course of efforts at reduction. These two obstacles in the way of a reduction may readily be overcome as follows: if the patient is anæsthetized with ether down to the level of ordinary surgical anæsthesia this method will not apply, but if the anæsthesia is continued until all the deep and superficial tendon reflexes are lost, until all normal muscular tone is lost, until a sharp tap upon the abdominal muscles with the finger is followed by no reaction, one can then take hold of the dislocated member and place the bone in position without any mechanical force at all. He had had opportunity of adopting this method in a few cases and had found it most successful.

MR. HAROLD J. STILES, of Edinburgh, Scotland, said that it seemed to him that if there is a dislocation of the hip-joint which cannot be reduced, be it congenital or acquired, the best thing to do is to remove the whole neck as well as the head of the femur, otherwise one will get an unstable joint afterwards. The neck of the bone will slide upward more and more, producing considerable shortening, whereas if one removes the whole of the neck and then rounds off the trochanter and places it in

the acetabulum, and puts the limb in the somewhat abducted position (which will compensate for the shortening), one will get a certain amount of stiffness, but will also get a stable limb.

#### OPERATIVE CURE OF INTERNAL HYDROCEPHALUS.

DR. E. WYLLIS ANDREWS, of Chicago, Ill., said that cases of acquired obstructive hydrocephalus are due to basal inflammations or other causes producing obstruction of the foramina of Leuschka, Magendie, or Sylvius. These, rather than congenital hydrocephalus, are the ones curable by operations. Operative treatment by drainage can be carried out from various sides, spinal canal, fourth ventricle, or lateral ventricles. The difficulty lies in making this drainage permanent without endangering the meninges from sepsis. The drainage of the ventricles must be into some absorbing cavity. The peritoneum, subcutaneous space, pericranium, and subarachnoid space have all been tried by V. Bergmann, Kocher, Keen, Ballance, and others. Cases were reported by Andrews in which gold or iridio-platinum tubes were made to connect the lateral ventricle and the subarachnoid space, causing permanent reduction of the distended ventricle. Rapid and permanent cure of one almost hopeless case followed the use of a light glass tube. The glass was used as less irritating and lighter substance than metal, and seemed to give better results. Skiagrams taken after five years showed the tube  $2\frac{1}{2}$  inches long exactly in the position placed by the operator. He therefore advocated the abandonment of all metals and the use of glass suitably molded in all these cases. It is absolutely inert to all chemical changes in the body fluids, and is safe against breaking inclosed in the skull. The fact that a  $2\frac{1}{2}$  inch tube can lie for years imbedded in the brain without causing symptoms or sensations is of clinical interest, and points to further possibilities in the use of glass objects in contact with tissue.

DR. LEWIS L. MCARTHUR, of Chicago, Ill., added that the idea came to him after reading an article by McBurney some years ago, that if instead of draining upon the skin surface of the body, as he had tried to do, he drained through the bony vault beneath the scalp into the cellular tissue of the neck, he would be enabled to secure a permanent drainage. He found a silver cannula, such as is used in the veterinary departments for milking cows, which having a small flange would prevent its dropping into the

skull, and would also prevent its falling out. He used this cannula with much success. The child, from being nervous and irritable, became much more normal in every way, although it died three years after operation from an intestinal complaint contracted during warm weather. He had operated upon two other cases after a similar manner also with good results.

DR. GEORGE E. BREWER, of New York City, said that in 1898 he attempted in a case of internal hydrocephalus to drain the ventricle into the subdural space by the method of making a flap in the back of the head and exposing the posterior lobes, and above this space exposing the tentorium; then, by a puncture into the lateral ventricle he introduced a small filament of rubber tissue flared to make a number of strands which did not totally close; the flanged surface lay on the tentorium and the perpendicular portion entered into the cavity of the lateral ventricle. The child recovered from the operation but lived only six or seven weeks. The head diminished in size and the symptoms grew no worse. He tried the same method in two or three other cases, but did not feel that the results warranted his continuing in the use of it. He does believe that any method which will allow the fluid to pass from the ventricles into the subdural space will be found ideal.

DR. JOSEPH RANSOHOFF, of Cincinnati, Ohio, said that he had tied the common carotid arteries in two children suffering from internal hydrocephalus, with most gratifying results. This method was first brought to his attention by the work of Mr. Stiles along these lines. With regard to the introduction of a foreign body to permit of permanent drainage of the ventricles, he thought a better method is that suggested by Brown. We have the roof of the lateral ventricle formed by a useless structure, the corpus callosum; this is very thin in all of these cases of distention of the lateral ventricle, and it is a simple matter to make a drill hole near the median line and through it pare off the corpus callosum, thus establishing efficient and permanent drainage without leaving anything in the interior of the skull to give rise to possible later trouble.

DR. CHARLES FRAZIER, of Philadelphia, Pa., stated that he had recently been treating a case after the method of Mr. Stiles, by tying the common carotids. The child is still in the hospital, but a few days ago was in extremely good condition, having bene-

fited very materially by this treatment, which has now been conducted for several months.

MR. HAROLD J. STILES, of Edinburgh, Scotland, said that in congenital hydrocephalus there is no blocking of the passages at the fourth ventricle; indeed the foramina in the roof of this ventricle are much larger than normal. That being the case, he does not think any form of drainage can be expected to do good in congenital hydrocephalus. He had never derived anything but temporary benefits from such methods. In congenital hydrocephalus there is a disturbance between the balance which should normally exist between the secretion and absorption of the cerebrospinal fluid. The indication is to diminish the secretion by ligaturing the common carotids, the one a fortnight after the other. The operation should be done early in the disease. He had never found it to do any good when the hydrocephalus was associated with spina bifida. In acquired hydrocephalus the indication is to drain the ventricle, because these forms are due to obstruction.

#### SUPPURATION IN ONE HALF OF A HORSESHOE KIDNEY.

DR. JAMES E. THOMPSON, of Galveston, Texas, read a paper with the above title, for which see page 355.

DR. WILLIAM J. MAYO, of Rochester, Minn., said that in a number of cases of horseshoe kidney observed at the Rochester clinic, the symptoms were caused by anomalous blood-vessels. In the last year they had met with three cases of horseshoe kidney in which one-half was giving rise to trouble, but in only one case was the trouble sufficient to necessitate operation. The diagnosis, in other words, does not necessarily mean that the case must be operated. He recalled one case somewhat similar to that reported by Dr. Thompson. The patient, a girl of 16, had severe symptoms, had undergone various operations; she had a few urinary symptoms, although there was a certain amount of pus in the urine. The ureter was found drawn tight, and was plainly visible, but the posterior ureter leading to the other half of the kidney was buried so completely that it was difficult to find the division between the two parts. This fact made the operation much more difficult than it would otherwise have been.

DR. GEORGE E. BREWER, of New York City, said that the case of the author was similar to one he had recently had under his

care. The patient came into his service in a state of more or less chronic sepsis and with a discharging fistula, resulting from a previous abscess in the lumbar region. He gave evidences of an infected kidney. The ureteral catheter was attempted and the cystoscope, but the presence of a very grave cystitis and a contracted bladder prevented any satisfactory employment of these measures. Dr. Brewer operated and found a chronically infected kidney. The upper part of the kidney was distinctly destroyed, the lower part infected, but as he passed down toward the transverse portion it looked healthy. Not having had the advantage of a cystoscopic examination, he was at a loss to know whether both ureters were given off on the left side, or whether there was a single ureter on the other side. It took a good deal of time to dissect away the perirenal exudate to see that another ureter was present. Fortunately, the man made a very prompt recovery.

DR. KENNETH A. J. MACKENZIE, of Portland, Oregon, mentioned the case of a young woman, a Swede, who came into his service complaining of pelvic discomfort. He attempted an examination, and found what he thought to be a tumor, very dense and unyielding. Operation was performed, no ureters were found, there was no vagina, and this tumor could be felt below the sacro-iliac synchondrosis in the pelvis. Above he found an ovary floating in the abdomen, and pulling it down found it led to a Fallopian tube and a segment of the uterus. The tumor proved to be a tremendous ectopic horseshoe kidney. Huge vessels connected with it, and nothing could be done; there were some adhesions and he could not see where the vessels came from.

DR. M. L. HARRIS, of Chicago, Ill., emphasized the necessity of conservatism in operating on horseshoe kidneys. Some six years ago he had a patient, a young woman 30 years of age, who was operated on for a movable kidney; this proved to be a mistaken diagnosis, a horseshoe kidney being found. There were two ureters coming from the pelvis, and the pelvis was on the concave side of the kidney and therefore dragged upward. The ureters were distinctly compressed, as they passed over the anterior surface of the kidney, and to this he attributed the existing dilatation of the pelvis. He attempted to free the ureters as they came from the kidney, and in order to do away with the sharp kinking or compression of the ureter he took

the perirenal fat and tucked it under the ureters to give them a large curve, and while doing this tore one of the renal veins, which was closed by suture. He then closed the wound. The patient made a very good recovery, and the attacks of pain ceased. About a year later she returned with distinct enlargement in the left side of the abdomen. Pus in the urine and tubercle bacilli were easily found. Knowing she had a horseshoe kidney, the question of what to do was a serious problem. He cut down on the left side, found a distinct pyonephrosis of tuberculous origin, and removed the left half of the horseshoe kidney. The patient made a good recovery and is now in perfect health. If anything radical had been done at the first operation on the right side of the horseshoe kidney there would have been no hope for the patient when the tuberculosis developed in the other side.

#### TREATMENT OF FISTULA IN ANO WITHOUT MUTILATION OF THE SPHINCTERS.

DR. KENNETH A. J. MACKENZIE, of Portland, Ore., read a paper with the above title, for which see page 360.

DR. THOMAS W. HUNTINGTON, of San Francisco, Cal., spoke of the importance of first dilating the sphincter ani in the exploration of anal fistulæ.

DR. CHARLES H. MAYO, of Rochester, Minn., said that the injection of collargol into these fistulous sinuses is of great advantage in locating the inner tract into the bowel. In deep fistulous tracts running past the internal sphincter, undoubtedly many of them connect with low diverticuli; very recently he had seen two such cases, and he believed them to be much more frequent than is thought.

DR. ARPAD G. GERSTER, of New York City, remarked that the most valuable part of the principle promulgated by the author was the avoidance of interference with the integrity of the sphincter, thereby preserving its function, which is accomplished by dividing the branches of the fistulous system from the source of supply of the infectious material.

#### THE CHOICE OF THE ANÆSTHETIC.

DR. ARTHUR DEAN BEVAN, of Chicago, Ill., read this paper.

## CHLOROFORM ANÆSTHESIA.

DR. JAMES E. MOORE, of Minneapolis, Minn., explained why he was not using ether as an anæsthetic after having used chloroform with perfect satisfaction for thirty years. He had had no sudden deaths or calamities; one case of acute yellow atrophy of the liver. He mentioned histories of two cases of death from yellow atrophy following ether as the anæsthetic. Death of a patient during or soon after operation from unknown causes is no proof that the anæsthetic caused death, but it usually gets the blame. Distinction should be made between death from anæsthesia and death during anæsthesia.

He originally chose chloroform because it was given then, as now, in the clinic he attended, by the drop method, and was efficient, safe, and comfortable, while ether, as given then, was disagreeable, tedious, and not free from danger.

The dangers from anæsthesia lie with the anæsthetizer rather than with the anæsthetic. Most deaths from all anæsthetics are due to the giving of too much of the drug, and chloroform being the more powerful is necessarily the more dangerous. Ether, as administered to-day on the open mask and by the drop method, is relieved of its former disagreeable features, and is safer than chloroform. Ether can be safely administered by a trained nurse, while no one but a graduate in medicine who has had special training should be allowed to administer chloroform.

The teaching of anæsthesia should occupy a prominent position in the curriculum of every medical college.

## THE USE OF REBREATHING IN THE ADMINISTRATION OF ANÆSTHETICS.

DR. W. D. GATCH, of Baltimore, Md., read a paper, the conclusions of which were as follows:

1. Rebreathing, when properly regulated and when the oxygen supply is ample, is harmless and can be put to a valuable use.
2. If we can prevent anoxæmia, over-concentration of vapor and too great a depth of anæsthesia, we can obviate most of the serious objections to the closed method of giving ether.
3. The process of rebreathing prevents the elimination of ether and chloroform by way of the lungs, and over-ventilation of the lungs hastens the elimination.



4. It is suggested that after any administration of ether or chloroform over-ventilation of the lungs be brought about by the use of oxygen and carbon dioxide.

5. Morphia, or any drug which depresses the respiration, retards the elimination of ether or chloroform.

6. A method of administering nitrous oxide, and, if necessary, ether with oxygen, by the method of rebreathing, is described and its advantages and dangers discussed.

Its chief advantages are: (1) the rapidity and pleasantness with which anæsthesia is established; (2) the ease with which any depth of anæsthesia can be secured; (3) the prevention to a very large extent of post-anæsthetic vomiting, pulmonary complications, and abdominal distention.

Its chief dangers are: (1) anoxæmia, due to a failure to give sufficient oxygen, or to an obstructed air way; (2) impediments to the respiration, which in a long anæsthesia may exhaust the patient; (3) with cardiac cases, excitement during the period of induction.

#### EXPERIENCE WITH INTRATRACHEAL INSUFFLATION AS A METHOD OF ANÆSTHESIA.

DR. S. J. MELTZER, of New York City. This paper, in the absence of the author, was read by title.

The essentials of the method of intratracheal insufflation consist in the deep introduction into the trachea of a flexible elastic tube, the diameter of which is much smaller than the lumen of the trachea, and the driving through this tube of a nearly continuous stream of air which returns through the space between the tube and the walls of the trachea. The distinguishing features of this method consist, first, in bringing pure air directly to the larger bronchi with the elimination of the dead space represented by the mouth, pharynx, larynx and trachea; second, the continuous recurrent air stream prevents the invasion of infectious material from the pharynx into the trachea. The usefulness of the method is threefold: first, by keeping up an efficient respiration in cases where the normal mechanism of external respirations fails; second, by overcoming efficiently the difficulties presented by double pneumothorax; third, it affords a safe and reliable method of anæsthesia, especially for the administration of ether.

The author cited a number of experiments where the insufflation anæsthesia lasted for hours, as long as twelve, without a single case developing any bronchitis or pneumonia which could be attributed to the anæsthetization; also experiments, which proved conclusively the impossibility of the inhalation of vomited material or blood from the pharynx. He then called attention to the difference between insufflation and positive pressure apparatuses, and how insufflation retains all the features of safety which the differential pressure does not do, for the life of the patient with double pneumothorax persists on a greatly reduced supply of external and internal respiration. The author then discussed the principles and methods of administering ether by this method.

#### FATALITIES, SIMULATING STATUS LYMPHATICUS, INDUCED IN NORMAL SUBJECTS BY INTERMITTENT ETHER ANÆSTHESIA.

DR. YANDELL HENDERSON, of New Haven, Conn., read a paper, which he prefaced by the statement that deaths under anæsthesia are usually either primary respiratory failure, or primary cardiac failure. The object of his paper was to show that the latter no less than the former are the result of unskilful methods of anæsthesia. Neither is necessarily due to any inherent hypersusceptibility in the patient. "Unsuspected heart disease" and "status lymphaticus" are usually mere excuses. Neither form of death is necessarily the result of anything done wrong by the anæsthetist at the time of death or for a few minutes previously. Both are really due to a hypersusceptibility developed in the patient by faulty methods at the beginning of anæsthesia. In particular a prolonged period of ether excitement or intermittency in the method of administering ether induces excessive respiration and diminishes the  $\text{CO}_2$  in the blood. This acapnia may lead later to failure of respiration. The effects of acapnia upon the heart are equally deleterious—in some subjects even more deleterious. In such persons the heart fails first. These points were supported by comparisons of typical clinical cases with experiments in which animals were rendered acapnic by intentionally unskilful anæsthesia. It was found that in acapnic dogs under ether respiratory failure developed, while under chloroform primary heart failure resulted. Healthy cats after

being rendered acapnic by light and intermittent etherization (with no chloroform at all) often died suddenly of heart failure. Conclusion: "Individual hypersusceptibility," "unsuspected heart disease," and "status lymphaticus" are usually mere excuses for fatalities really due to light and intermittent anæsthesia.

DR. JOHN B. ROBERTS, of Philadelphia, Pa., said that death in general anæsthesia was usually due to poisoning from incompetent administration. Poisonous agents administered for any purpose should seldom be entrusted to non-graduates, in fact never unless the administration is supervised by a graduate in medicine. The hypodermic administration of morphine and atropin is well known to be in ordinary cases practically free from danger; it lessens the fear, which is an important factor in anæsthesia, lessens the amount of anæsthetic required, and, as proved by Claude Bernard thirty years ago, is good to use as a preliminary to general anæsthesia. With regard to the method of administration, he thought that of pouring a little of the ether upon a few layers of gauze full of holes, covering this with a closely woven towel to prevent too rapid loss of ether upward, increasing as it does the carbon dioxide rebreathed, is the simplest, best and most generally useful method of administration.

DR. CHARLES A. POWERS, of Denver, Colorado, remarked that in Colorado they had many tuberculous patients, and in his practice the anæsthetic used, as a general rule on such patients, is ether. He had always found it very satisfactory. In the present state of knowledge he believed that ether, given by the drop method, is the safest and most desirable general anæsthetic. There are comparatively few cases in which it is not well tolerated when carefully given. Applicants for positions in surgical departments do not make the best anæsthetists, for they are too much interested in the operations. He had a skilled anæsthetist who had no interest in the operative work of surgery other than such as may attach to seeing a patient safely through a given operation. When possible, he examines the patient one or two days before operation. He obtains the history, he makes a thoracic, and, when necessary, abdominal examination, he examines the urine and the blood. He learns the nature of the operation to be performed, and approximately its duration. When he gives the anæsthetic he knows the patient and the patient knows him. The patient is less apprehensive under these circumstances,

he or she feeling that the matter of anæsthesia is being given careful attention. The psychic shock is lessened, the importance of which was emphasized by Dr. J. Bapst Blake two years ago. He was rather apprehensive regarding the administration of the ethyl chloride compounds, and did not permit them to be used by any but highly skilled anæsthetists. Patients should wear, approximately, the same clothing while in bed in the hospital in which they are accustomed to sleep when at home; and they should be scrupulously protected from taking cold before, during and after the anæsthetic. The entire matter of anæsthesia should be made the subject of careful study at the hands of men or women especially adapted, temperamentally, to its administration. It should not be made, as is so often the case, a matter of chance.

DR. HOWARD LILIENTHAL, of New York City, spoke with regard to intratracheal anæsthesia, with which he had had some experience, and which he had seen administered at the hands of Dr. Elsberg many times. The patient is absolutely quiet under this anæsthesia; there are not the usual signs of rattling and stertor in the throat as in other forms of inhalation anæsthesia; the breathing can be made as slow as desired, can be stopped altogether for some minutes if advisable; in operations upon goitres, cranial operations, chest operations, or any other operation except some upon the abdomen where it is at times difficult to overcome the rigidity, the procedure is the same as though operating on a person in a state of trance; the patient is entirely apneic, like a cadaver, except the vessels spurt when cut. In a large goitre, after the tube is in, everything is perfectly quiet, the patient does not have the customary spasmodic swallowing motions, and one can operate at his ease.

DR. LEONARD FREEMAN, of Denver, Colorado, confirmed the statement of Dr. Powers, that in Colorado ether was given with perfect confidence except in cases where tuberculosis is in an active state or very far advanced, and that no ill effects result from it. Whether this is due to the inhibitory influence of the climate and altitude or because ether does not disturb these cases, he was not in a position to state.

DR. FRED B. LUND, of Boston, Mass., called attention to the use of local anæsthesia in cases of strangulated hernia. There is no way of giving a general anæsthetic in strangulated hernia

where the patient is constantly vomiting brown fluid (unless the intratracheal method would do it), without danger of the patient inhaling some of the vomitus. Strangulated hernia has lost its terrors since operations are done on the conscious patient under cocaine. He fully agreed with Dr. Lilienthal's remarks on intratracheal anæsthesia, and believed it has a great place, especially in head and neck operations. He also believed that spinal anæsthesia has a place in amputation of the legs in diabetic patients.

DR. CHARLES N. DOWD, of New York City, said that his experience with the intratracheal insufflation method of anæsthesia has, like that of the former speakers, been most satisfactory in every case. With regard to the question of status lymphaticus he remarked that most of these cases occur in children, and he believed are in truth due to faulty methods of administration. Children are particularly susceptible to anæsthesia, and it is not an uncommon thing for a person skilled in giving anæsthesia to adults to get a child so deeply anæsthetized as to produce this condition called "status lymphaticus." Children should be most carefully anæsthetized, and an anæsthetist who does not understand the difference between administering a general anæsthetic to a child and to an adult should not be allowed to take charge of children's cases. All surgeons have gone through the period where the junior on the house staff of the hospital gives the anæsthesia under slipshod instruction. Personally, he had obtained the best results where a nurse has been thoroughly instructed and gives the anæsthetics for months and years. The difficulty in many hospitals at the present time in having a professional skilled anæsthetist is the question of additional expense to the hospital; but he felt sure that the managers of such hospitals will soon see that it is due both to the patients and to the operating staff to install a different regime.

DR. JOSEPH RANSOHOFF, of Cincinnati, Ohio, remarked that the only death that he would consider absolutely with justification attributable to anæsthesia is the one occurring before the surgeon has used the knife or applied a ligature to any vessel. With regard to spinal cord anæsthesia, he had used it a good deal and considered it has a very definite place in cases with bad kidneys, hearts which could not safely be entrusted to ether or chloroform, and in cases of diabetic gangrene requiring amputation.

DR. THOMAS W. HUNTINGTON, of San Francisco, Cal., said with regard to spinal cord anæsthesia, he had used it a great deal with most gratifying results both to himself and to his patients. It must, however, be remembered that the death rate from spinal anæsthesia when used as a *routine* measure is too great to warrant its employment except in selected cases.

DR. ROBERT G. LE CONTE, of Philadelphia, Pa., said that just before coming to this meeting he removed the leg from a patient suffering from diabetic gangrene, and as usual in such cases found the employment of spinal cord anæsthesia most satisfactory. This form of anæsthesia has a very limited field, but under certain conditions, such as mentioned by the former speakers, he considered it the safest anæsthetic.

DR. ARPAD G. GERSTER, of New York City, said that he was brought up in the chloroform school and used it for many years in his surgical practice, but finally abandoned it for ether because of the uncertain and unreliable administrations of it at the hands of changing anæsthetists. He now restricted its use to those cases only in which it is especially indicated, other forms of anæsthesia being contraindicated. He had found spinal anæsthesia useful many times, and agreed that, although limited, its field is very definite. With regard to the administration of anæsthesia, he was taught in Billroth's clinic to be most careful in administering an anæsthetic to those patients who showed signs of fear at the time of administration. He never realized fully until hearing the papers of Dr. Crile and of Dr. Henderson just why this precaution was necessary, although he had been careful to teach the same precaution to his own students.

MR. HOWARD J. STILES, of Edinburgh, Scotland, spoke in defence of chloroform. Dr. Henderson's paper gave an explanation of why it is safer to have chloroform administered by a person not afraid of it. It is a good thing, and advisable in this country, that ether should take the place of chloroform, because American surgeons are afraid to give enough chloroform. Since a visit to Dr. Mayo's clinic five years ago he had become a partial convert to ether, and now uses it in 75 per cent. of his cases, because he recognized that it was safer than chloroform. Personally, he was not afraid of chloroform on the operating table, if it is given by a man who knows how to give it and is not afraid of it. He was afraid, however, of its after effects.

He had had about 12 cases of delayed chloroform poisoning. What is the relation between delayed chloroform poisoning and sepsis? If the sepsis originates in the abdomen the liver has to deal with the poisons. Suppose a gangrenous appendix is removed under chloroform; what happens? The bacterial toxæmia is intensified by the chloroform which is the last straw, and the patient dies. The moment he stopped giving chloroform in acute appendicitis his results showed a very striking improvement. There are certain conditions, however, in which chloroform is indicated. For instance, in alcoholic patients, in operations in which there is likely to be considerable loss of blood, and in operations in which it is important to work with haste. Personally, he always used chloroform in breast cases in preference to ether, because there is but half the amount of bleeding, and consequently the operation can be done comfortably within an hour. With regard to the special apparatuses for the administration of anæsthetics, even if they are a little cumbersome, if one can get a better and safer anæsthesia, it is a duty to employ them. It had been his privilege to see Dr. Elsberg's apparatus used in Dr. Meltzer's intratracheal method of administering ether, and he was very much impressed with it. It was the simplest, smoothest, and most delightful anæsthesia he ever saw. He was also favorably impressed with the nitrous oxide and oxygen anæsthesia, which he saw both at Johns Hopkins and at Dr. Crile's clinic.

DR. C. B. G. DE NANCREDE, of Ann Arbor, Mich., said that there was one point in regard to the use of ether as a general anæsthetic which had not been mentioned. In military service it is absolutely impossible to give ether after a big battle. Enough ether cannot be carried in the first place, and the surgeon cannot take the time to properly administer it in the second place. Again, if it is a hot climate, in the tropics, it is extremely difficult to get a patient under ether; it is very difficult even in this country when it is very hot to get some patients under ether. He had no hesitancy in saying, after forty years' experience with anæsthetics, that he preferred ether to any other general anæsthetic, but he did not confine his practice to its sole use. And in the class of cases mentioned above, he was of the opinion that chloroform should be employed.

EXTIRPATION OF TUMORS OF VOMER THROUGH THE  
ROOF OF THE MOUTH.

DR. CHARLES H. MAYO, of Rochester, Minn., read a paper with the above title, for which see page 302.

DR. ALBERT E. HALSTED, of Chicago, Ill., had operated on a number of these cases. The first method he tried was the one described by Feidallot, the temporary resection of the alveolar processes of the superior maxilla dropping down near the hard palate. That operation gave an excellent field to work through, but caused a great deal of deformity, and the after results were not satisfactory, it being difficult to replace and keep the bone in place. The second method was the one he later adopted for the removal of the hypophysis, known as the Loewe method; an incision is made underneath the lip, and the lip turned up toward the top of the head. This method also gave an excellent view of the tumor, and made it extremely easy to work in the nasopharynx. The third time he tried a method of splitting the palate and removing the tumor through the mouth. The difficulty with this method was that a necrosis of the hard palate resulted and he could never afterwards close the opening completely. Therefore, from his experience, he strongly advocated the method of Loewe for the removal of tumors of the vomer.

ARTERIOVENOUS ANASTOMOSIS FOR GANGRENE OF THE  
LEG.

DRS. ALBERT E. HALSTEAD and ROGET T. VAUGHAN, of Chicago, Ill., presented a paper on the above subject, the conclusions of which were as follows:

1. There is experimental evidence to show that in animals the circulation through the large veins of the extremities may be reversed, and that it is possible for the normal blood-pressure in the arteries to overcome the resistance of the valves of the veins.
2. Experimental and clinical evidence show that the anastomotic opening is not permanent, but that gradual obliteration takes place in event of the failure of early occlusion by a thrombus.
3. There is not sufficient clinical evidence to be deduced from the reported cases to show that the pressure of the blood in



the arteries in the cases operated upon was sufficient to force the valves in the veins.

4. It is also shown by the cases reported that early occlusion of the vessels about the anastomotic opening by a thrombus was the rule, and in many the opening never at any time functionated.

5. In event of the arterial blood forcing the valves in close proximity to the anastomotic opening, it returned through the communicating veins and did not traverse the capillaries as a rule.

6. A study of traumatic arteriovenous aneurism shows that with a normal arterial pressure it requires weeks or months for the valves in the communicating vein to be overcome, as is evidenced by the gradual development of varicosities and the long delayed pulsation in the veins remote from the seat of aneurism. Under these conditions, the arterial blood supply is maintained partly through the usual collateral channels which are unobstructed. In cases of gangrene from obliterating diseases of the arteries, the collateral vessels are already occluded. In such a case immediate reversion of the circulation is imperative. This cannot be accomplished because, (1) of the obstruction offered by the valves; (2) in many cases the circulating blood must overcome the resistance offered by the thrombosed vein; (3) the blood will return often through the nearest communicating vein—and will not reach the peripheral capillaries.

7. Their final conclusion was that there is but one indication for the application of arteriovenous anastomosis in surgery; that is, in traumatic destruction of a principal artery, where end-to-end union of the vessel is impossible. In such a case arteriovenous anastomosis might be attempted, and through it we might maintain a sufficient blood supply to preserve the integrity until an adequate collateral circulation was established.

DR. HOWARD LILIENTHAL, of New York City, expressed the opinion that there are certain cases of diabetic gangrene in which the arteries are not diseased where arteriovenous anastomosis will be found practicable. Where both arteries and veins are diseased it naturally does no good to anastomose one diseased vessel with another.

DR. FRED B. LUND, of Boston, Mass., had had some experience with arteriovenous anastomosis and had never found it of

SOME MODIFICATIONS OF TECHNIC IN THE SURGERY OF  
THE GALL-BLADDER AND BILE-DUCTS.

DR. JOHN E. SUMMERS, of Omaha, Neb., read this paper, for which see page 110.

DR. LEWIS L. McARTHUR, of Chicago, Ill., seconded Dr. Summer's remarks regarding the minimum of surgical interference in cases of acute septic gall-bladders. So much better results are obtained by the method he outlines that it should appeal to everyone. The utilization of the bowel tract, which has been opened and drained, as a drain for relieving the kidney from colomic sepsis and other conditions dependent upon long continued biliary trouble, had proven in his hands of so great value that he urged those who had never tried it to do so. In those cases in which the common duct is being drained, insert the drainage tube into the common duct an inch or so downward, instead of, as heretofore practised, upward toward the liver. With the tube inserted in this way an ordinary ureteral catheter can be passed into the common duct and will find its way readily into the duodenum, and irrigation of the intestinal tract can be easily accomplished. Nourishment can also be administered, when necessary, through this channel.

DR. CHARLES H. MAYO, of Rochester, Minn., heartily agreed with all Dr. Summers had said regarding the treatment of the gall-bladder and bile-ducts, and particularly to the necessity for the careful treatment in septic cases. He had had good results from the use of salt solution washed through the cystic and common ducts into the intestines.

## BOOK REVIEWS.

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BISMUTH PASTE IN CHRONIC SUPPURATIONS. By EMIL G. BECK, M.D., Surgeon to the North Chicago Hospital. 8vo, pp. 237. C. V. Mosby Co., St. Louis, 1910.

It is now some six years since the author noticed that a tubercular sinus which he had injected with a bismuth and vaseline mixture for diagnostic purposes closed and remained so. The results which have accrued to the department of surgical therapeutics from that seemingly accidental observation have been so notable that the publication of a monograph on this method of treatment of persistent sinuses by its originator is very acceptable.

In it we find a graphic recitation of Dr. Beck's personal experience and the gradual development of the art of bismuth treatment, as one after another the various regions and organs in the body have been attacked.

The book is profusely illustrated, and consideration of these plates alone should indicate to us our absolute inability to diagnose certain lesions without the aid of bismuth paste and the X-ray. Further reason for the general adoption of this method is found in considering the fact that not only are diagnostic errors revealed but curative treatment is applied at the same time.

The author states that he believes the reason for cure of these sinuses, especially those of tubercular nature, is due, first to the destruction of the tubercular bacilli by the chemotactic properties of the bismuth subnitrate; second to the mechanical dilatation of the walls of the sinuses; and third to exposure of the injected sinuses to the X-ray.

Some consideration is also given to the lately developed art of stereoscopic radiography. The formulas and methods of administration in various conditions are given in a thorough and terse manner.

To those having patients with persistent sinuses, the treatment as described by Dr. Beck is sincerely recommended, and a thorough and comprehensive consideration of it is to be found in this admirable monograph.

DISEASES OF THE ANUS, RECTUM, AND SIGMOID. By SAMUEL T. EARLE, M.D., Professor Emeritus of Diseases of the Rectum, Baltimore Medical College. Philadelphia and London: J. B. Lippincott Co., 1911.

The author has obviously endeavored to prepare a book on this most important subject which may be used as a reference for general practitioners and students rather than the proctologist. He has succeeded in incorporating in it the great majority of approved procedures which have been developed in the treatment of the pathologic conditions in this region.

Minor differences in pathology and malformation have been omitted, types having been offered which simplify and make easy quick reference. Minor steps in operative technic have likewise been intentionally and justifiably omitted. The text is well illustrated by instructive cuts and line drawings, which go far toward elucidating and simplifying the subject matter. The general subject is well covered, and the book will be appreciated as a valuable addition to our literature.

DISEASES OF THE PANCREAS, ITS CAUSE AND NATURE. By EUGENE L. OPIE, Professor of Pathology, Washington University, St. Louis. Second Edition, pp. 387, 44 illustrations. Philadelphia: J. B. Lippincott Co., 1910.

Since Claessen in 1842 put forth the first monograph on this subject, the knowledge of physiology and pathology has been very progressive, but until the last decade interest was confined chiefly to research and pathological laboratories. The previous edition of this work, which appeared seven years ago, collated the observations of contemporaneous investigators and elucidated many obscure problems pertaining particularly to the diseases dependent upon the peculiar physiology of the pancreas, namely, hemorrhagic necrosis or acute hemorrhagic pancreatitis, fat necrosis, and diabetes mellitus.

While the experimental aspect of these problems has continued to receive marked attention, the greatest advances in our knowledge of this organ and its diseases have been through the observations of surgeons and the pathologic findings in the living tissues, which have so markedly altered many of the views previously formed from autopsy records.

Thus we have been able to diagnose even grossly between

interlobular and interacinar types of fibrous tissue proliferation, and similarly the clinician can now distinguish between the same types in a majority of instances. The author regards the diagnosis from the view-point of a pathologist rather than that of a clinician, and exceptions will be taken by some observers to the statement on page 243 that "chronic pancreatitis is rarely accompanied by such definite symptoms that its recognition is possible during life," because when the laboratory worker and the clinician are able to work together in full knowledge of what each has found, practically 80 per cent. of the cases may be diagnosed and in many instances even the type of pathologic change surmised.

The most interesting chapters in the book are those on hemorrhagic necrosis, chronic pancreatitis with its subdivisions of the interlobular and interacinar types, and the one on the pancreatic pathology of diabetes mellitus, into which the author has gone with much detail. His adherence is remarked to the former views which he held regarding the essential lesion in the cases being found in the islands of Langerhans. The various theories of the other men are, however, freely discussed. Indeed, throughout the entire work one finds a wealth of references to the literature and a full appreciation of the work and observations of the other experimenters.

Atrophy of the pancreas is not considered very fully except in the references to Hansemann's work; however, this is one of the very recent advances and will doubtless be mentioned more in detail later.

The book is authoritative, well illustrated, clearly written, and presents very well the great advances which have been made in this subject to date.

JAMES T. PILCHER.

A MANUAL OF GYNÆCOLOGY. By THOMAS WATTS EDEN, M.D., F. R. C. S., Edin. 632 pages, 272 Illustrations in text. Philadelphia, P. Blakiston Son & Co.

This is a manual of gynæcology, not a formal treatise, and in the preface the author says, "the object with which the manual has been written is to provide students and general practitioners a complete but not exhaustive account of the diseases of women in their pathological and clinical aspects . . . . Subjects at

present imperfectly worked out have been dealt with by eliminating speculative matters. . . .”

The volume is divided into fifteen parts. Part I treats of anatomy and physiology of the female genital organs; II, methods of examination; III, certain prominent gynæcological symptoms; IV, disorders of menstruation; V, morbid conditions of the uterus; VI, morbid conditions of the ovaries; VII, morbid conditions of the Fallopian tubes; VIII, extra-uterine pregnancy; IX, morbid conditions of the vagina and vulva; X, malformations; XI, major gynæcological operations; XII, after-treatment of major operations; XIII, therapeutical notes.

For clear, logical, and comprehensive statements, there is little to be desired, and the illustrations accompanying are of a high order, and taken together serve admirably to enforce the author's teachings. The illustrations showing the relations of the vagina, bladder, and rectum follow the old methods by showing each as a distended organ, which is not in keeping with Nature's facts in the case. Notwithstanding these minor defects, which are not peculiar to the author, they do not mar the general accuracy of statement.

The student or practitioner who familiarizes himself with the teachings of this manual and has the technical ability to carry them into actual practice will rank as a competent gynæcologist.

The work is a credit to the genius and learning of its distinguished author.

WALTER B. CHASE.

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FIG. 1.



Fracture of pisiform bone of right hand; supine position; fracture at X.





# ANNALS OF SURGERY

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## ORIGINAL MEMOIRS.

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### A STUDY OF THE INFECTIONS.\*

BY ALGERNON T. BRISTOW, M.D.,

OF BROOKLYN, NEW YORK.

*Clinical Professor of Surgery at the Long Island College Hospital.*

HOSPITAL laboratories have for many years devoted their energies to the study of morbid tissues, but only occasionally to the bacterial origin of the infections. The desultory work which has been done has been in a few large hospitals connected with teaching institutions and a few others with ample means and a large laboratory staff. The study of infections from the bacteriological standpoint has not received the importance which it deserves. With the discoveries of Sir Almeroth Wright, however, and application of his principles to the creation of an artificial immunity in individual infections, the bacteriology of surgical diseases assumes new significance.

Important as the study of tissues undoubtedly is, particularly from the diagnostic standpoint, the study of the infections assumes at least equal importance, more particularly, however, from the viewpoint of therapeutics which is, after all, the goal of our art. The chief reason for the relative neglect of this important branch of hospital work has been, no doubt, the enormous amount of time which such investigations require. The average hospital pathologist, sometimes paid, more often unpaid, has quite enough to occupy

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\* Read before the American Surgical Association, June 19, 1911.

himself with the tedious preparation of morbid tissues for the final judgment of the microscope without dabbling in the mazes of bacteriological work. If this branch of pathology is to receive the attention which its importance deserves, we shall have to add to our hospital staff a paid bacteriologist, who shall have nothing else to occupy his time save the hunting down of infection and the making of vaccines. From the writer's experience of more than three years with vaccines, it is his opinion that Wright's work has added a most valuable weapon to our armamentarium against disease. We have only begun to know how to use bacterial products. We are but on the threshold of our investigations into the problems which are involved in the production of artificial immunity. Antisepsis and asepsis secured us to a wonderful degree against wound infections following the surgeon's knife. Wright's methods promise a victory over primary infections against which our only remedies hitherto have been incision, drainage, and the natural resistance of the patient, which has too frequently proved insufficient to the task.

A case of primary infection which occurred in the writer's service two years ago emphasized most strongly the prime importance of the fact that in each infection the bacteriological source should be traced. The case has been published in full in the *New York State Journal of Medicine*, but may be briefly referred to here.

In March, 1909, an Italian came into the writer's service at the Long Island College Hospital with a sinus leading down to some carious bone at the angle of the jaw. No cultures were taken previous to operation, and there was nothing to indicate the presence of anything unusual. Operation was done and the carious bone removed. The reaction to operation was somewhat severe but subsided and the sinus closed without incident, nor was there ever any serious infection of the face. A week subsequent to the operation the man began to complain of atrocious pains in the calves of the legs. Finally it was evident that an abscess had formed in the left calf, and it was opened and found to contain grumous bloody pus. Through the

courtesy of the Hoagland Laboratory, cultures from the pus were taken at the time of the drainage. Subsequently a similar suppurative process occurred in the right forearm. The infecting organism, to the astonishment of everybody concerned, proved to be that of glanders, of which the patient had not a single symptom. There were no farcy buds, no nasal discharge, nothing save the suppurative processes in the left leg and right arm, which did not differ from ordinary metastatic foci, excepting the grumous character of the pus, which, while a feature of the suppuration of glanders, also occurs in other infections, being ordinarily simply an evidence of a low grade of resistance on the part of infected tissues.

Time does not here serve to go into the case at length. It was fully reported in the May, 1910, number of the *New York State Journal of Medicine* by the writer, the laboratory work being described by Dr. Benjamin White, the director of the Hoagland Laboratory. Suffice it to say that the organism gave the Strauss reaction with guinea pigs and agglutinated known cultures of the *Bacillus mallei*. An autogenous vaccine was made from the patient's own organism. He recovered after an illness of five months, and when last heard from had remained well. He had worked along shore previous to his illness, but had not been especially in contact with horses. Every effort was made to trace the source of his contagion but without success. One thing was certain—he had glanders.

This case is mentioned, not only on account of its interest because of the therapeutic success attending treatment, but also because it emphasizes in a particularly striking manner the necessity and the value of bacteriological work in connection with the infections. Had it not been for the friendly aid of the Hoagland Laboratory this man would have been treated as an ordinary case of metastatic abscess and many persons placed in great danger. With the possible exception of the bacillus of pest there is no organism which has claimed so many laboratory victims as *Bacillus mallei*. True, we ought always to exercise the greatest precautions in treating all infections, but when the treatment extends over weeks and daily dressings are required, vigilance is too often relaxed,

with results which are unpleasant with ordinary infections, but which might be deadly with so terrible an infection as that of glanders.

During the fall of 1910 the Directors of the Hoagland Laboratory offered to put at the disposal of the Long Island College Hospital the services of Mr. H. W. Lyall for bacteriological research into the origin of all surgical infections treated in the hospital. This offer was gladly accepted, and the cases here analyzed were those which came under the charge of the writer the past winter, together with a few others from the other operations in the hospital. A number of times Mr. Lyall went with the writer to the Kings County Hospital for similar investigations, and a few cases from that hospital are included in this report. The period of observation has been too short and the cases too few yet for our records to be more than suggestive. If attention is called to the great importance of this work so that it becomes a part of the hospital routine, which is not at present the case, the writer will feel that something has been accomplished.

#### BACTERIOLOGICAL ROUTINE.

*Collecting of Material.*—The following rules were observed:

(a.) Apply no germicides to an open lesion, or if such substances have been applied wash with sterile water and wait at least two hours before taking specimen.

(b.) Avoid contamination either from the person of the operator, instruments and supplies, the patient, or his environment.

(c.) Discard the first or top pus. Take the specimen from the depths of the lesion, thus avoiding dead or attenuated organisms.

(d.) Make inoculating smears upon the surface of at least two Löffler blood-serum slants.

(e.) Avoid exposing the cultured material to extremes of heat or cold and delay in incubator.

(f.) Make at least two smears upon glass slides and fix by gentle heating.

The only addition to these procedures is in the case of lesions whose cause is known or suspected to be a very delicate organism, *i.e.*, influenza bacillus, gonococcus, etc., when media richer in animal proteid is supplied, such as blood or ascitic agar.

*Laboratory Procedure.*—When the specimen reaches the laboratory it goes through the following routine:

(a.) Stains—Gram's method and with Löffler's alkaline blue and in certain cases an acid fast stain. This serves as an inventory and an attempt is made to recover from the plates all organisms thus demonstrated in the exudate.

(b.) Plates are prepared of suitable media, the usual one glycerin agar. The laboratory custom in plating is the use of the ordinary streak or the Conradi method.

(c.) Incubation of the plated material at incubator ( $37.5^{\circ}$  C.) and at room temperature.

(d.) Under certain circumstances anaërobic conditions are supplied.

(e.) Study of and fixings from the colonies developed on the plates and isolation in pure culture.

(f.) Identification of species by the use of differential media, animal inoculation, and immunity reactions. Blood cultures are made through an incision of the properly sterilized skin over the median basilic vein. The blood is either immediately placed into the culture medium or first introduced into an isotonic and decalcifying solution. The latter method is used if culture material is not available at the bedside. For inoculation, 5 c.c. of blood are placed into at least 100 c.c. of fluid medium and the remaining 5 c.c. of blood are distributed in plates. The fluid medium most used is neutral broth. Under certain conditions dextrose broth, lactose bile, ascitic broth, and neutral broth to which calcium carbonate has been added are used. The plate medium ordinarily used is plain agar to which may be added ascitic fluid or other enriching material.

During the winter there were 108 cases of infection examined for the writer at the Hoagland Laboratory. The cases of ruptured appendix were not here included, some thirty in number, as the resulting cultures were so rich in intestinal flora that conclusions as to the infection were not of much value. Intestinal or sewage streptococci were quite common. The colon bacillus was invariably found, not often in pure culture. The first place among the flora of the intestine in appendical infections must always be given to the colon group. It occurred in over 90 per cent. of the cases. After that, to the streptococcus. We know little as yet about the varieties of the streptococci. There is one variety, however, the individual cocci rather small and clear cut, occurring in chains of five or six members and deeply stained, which is always associated with a virulent infection. Shorter chains of four or five members, the individual cocci rather large, have never been observed as associated with the

severe types of inflammation. The 108 cases which we analyzed have been classified according to the infecting organism, and occurred as follows:

<i>Staphylococcus aureus</i> , pure culture.....	25
<i>Staphylococcus aureus</i> , mixed .....	18
<i>Streptococcus pyogenes</i> , pure culture ....	22
<i>Streptococcus pyogenes</i> , mixed .....	13
<i>Staphylococcus albus</i> , mixed .....	6
Colon, pure (not including appendix cases)	11
Colon, mixed .....	1
Pneumococcus, pure .....	11
<i>B. Friedlander</i> , mixed .....	2
Pyocyaneus, pure .....	1
Pyocyaneus, mixed .....	3
Diphtheroid, pure .....	1
Diphtheroid, mixed .....	22

The appearance of a bacillus closely resembling the Klebs-Löffler bacillus so frequently in 22 per cent. of the cases is perhaps the most interesting observation in this short series of cases. It occurred once in pure culture in a granulating sinus of the thigh, following an operation for necrosis; twelve times in association with the *Staphylococcus aureus*; twice with *Staphylococcus albus*, both times in acne cases; once in conjunction with the *Streptococcus pyogenes* and *aureus*; once with *Bacillus coli* and a sewage streptococcus. It also occurred in the medical wards with mild cases of sore throat not accompanied by exudate or any serious constitutional disturbances. One case is typical of all, as follows:

J. F. recovered from typhoid fever, complained of sore throat. No exudate. Cultures from swab could not be distinguished from true Klebs-Löffler bacilli. Neisser granules found. Not pathogenic to animals. Guinea-pig inoculated intraperitoneally after an interval of two weeks in good health; autopsied; adrenals clear; no adhesions; everything normal. This man was quarantined for two months by the board of

health. During this interval he had no sore throat. This mild sore throat appeared in five post-typhoidal cases all in the same ward. In no case was the culture to be distinguished from the true Klebs-Löffler, neither was it considered to be a non-virulent diphtheria organism. Occurring in twenty-two cases of mixed infection it cannot be said, so far as was known, to have added to the severity of the case. It was most frequently associated with aureus (12 cases), next in frequency with the streptococcus (5 cases). Dr. C. F. Garside of the Hoagland Laboratory writes as follows concerning the classification of this organism:

*Pseudodiphtheria Organisms.*—The following tentative classification of the diphtheria and diphtheria-like organisms has been adopted by the laboratory:

1. True, virulent Klebs-Löffler bacilli.
2. Avirulent Klebs-Löffler bacilli.
3. Hofmann's pseudodiphtheria bacillus.
4. *Bacillus xerosis*.

5. Diphtheroids: Organisms which resemble the true diphtheria bacillus in the following essential features: gram positive, non-motile, non-sporulating bacilli which show a parallelism in their arrangement in smeared preparations and which fail to take the alkaline methylene blue stain in one or more areas of their protoplasm, *i. e.*, beading or barring. These organisms differ from types Nos. 3 and 4 in their sugar reactions. Diphtheroids may be divided into the virulent and the avirulent. The methods used for differentiating these classes are, first, pathogenicity to guinea pigs, and, second, fermentative reactions upon various sugars.

1. Animal pathogenicity: The avirulent Klebs-Löffler bacillus can be differentiated from the avirulent diphtheria-like organisms by its reaction on carbohydrates, notably its ability to ferment dextrin. The virulent true Klebs-Löffler bacillus can be separated from the virulent diphtheroids by animal inoculation, first protecting the experimental animal by immunizing it with diphtheria antitoxin, or by mixing the inoculating dose with diphtheria antitoxin. In either case the animal will survive inoculation with diphtheria bacilli, but will not be protected from the virulent diphtheria-like bacilli.

2. Fermentative reactions: Under ideal conditions distinct differences are brought out by this method, but certain variations in the reactions of the same strains, because of varied conditions, little understood and difficult to control, have cast some doubt upon the advisability of accepting such evidence as final. Consequently we rely upon the evidence supplied by animal inoculation of differentiation between the true Klebs-Löffler bacillus and its allied forms. For the present, the classification of the diphtheria-like organisms and the avirulent true Klebs-Löffler bacillus is based on their fermentative reactions and their cultural characteristics.

The importance of making the distinction between true Klebs-Löffler bacilli and the diphtheroid group cannot be overestimated. A hospital staff could easily get panic-stricken if the diphtheroids were not differentiated as indicated. In the absence of the clinical signs of diphtheria it is evident that the ordinary board of health methods will not avail, nor the presence of the Neisser granules, sometimes considered pathognomonic, be at all conclusive. The only trustworthy methods of differentiation are the behavior of the two organisms with the sugars, plus animal inoculation.

Four of the post-typhoid cases having diphtheroids in the throat were isolated and given special nurses, also isolated, for long periods of time, far longer than was necessary to determine the exact nature of the organism. The hospital and boards of health must always err on the safe side. At the same time we ought to recognize the fact that diphtheroids do exist which are non-pathogenic and, so far as known, without influence on wounds. The single case in which a pure culture of diphtheroid was isolated from a granulating sinus recovered without any untoward symptom. Further observations on the behavior of this organism in wounds and its influence thereon are most desirable.

The number of closed infections with pure cultures of aureus, streptococcus, pneumococcus, and colon bacillus was of great interest. It was impossible to trace the path of the infection in any of the cases, as they were all seen late in the course of the affection when a definite abscess had developed, and it was not possible to discover the origin, whether hæmatogenetic or by the lymphatic paths from mouth, tonsil, or the intestinal tract.

The following cases of aureus infection were not preceded by abrasion or wound. From a subdiaphragmatic abscess a pure culture of aureus was obtained. No history of ulcer of the stomach obtainable; no pleurisy. Six cases of prepatellar bursitis were treated and cultured. Like the carbuncles of the neck, of which there were five, from all a pure culture of aureus was obtained. One of the cases of prepatellar bursitis was opened



early before sinus formation. The swelling was of two weeks' standing. There was no abrasion of the skin. Pure aureus was obtained from the abscess cavity when opened. A case of osteomyelitis of the lower end of the tibia in a child of twelve years, of unhealthy appearance, had been preceded by several aggravated furuncles of the face. Cultures obtained from the bone abscess when opened proved to be aureus. The furuncles had healed at this time and could not be cultured. Many cases of osteomyelitis are said to be preceded by tonsillitis. It is evident that in all these cases of osteomyelitis the infection must be by the blood stream and not against the lymphatic current by way of the lymphatics. A second case of osteomyelitis, a Brodie's abscess, was as follows:

A young woman of twenty-five years, domestic, came under the writer's care suffering from pain in the lower portion of the left tibia and a temperature range of  $100^{\circ}$ – $102^{\circ}$ . Eight years previous she had suffered from an osteomyelitis of the same tibia, which had been operated. After recovery the intervening years had been free from illness until two weeks before writer saw her. The Röntgen ray showed a shadow at the lower end of the tibia about four inches from the malleolus. On cutting down on this spot the bone percussion note was dull, and, on trephining, a well walled off abscess cavity was found, cultures from which, made from the interior of the bone cavity, proved to be mixed, albus and streptococci in long chains. The cavity was filled with bone wax and the patient made a good recovery.

It is difficult to trace the infection in this case or to see why albus, which is a skin organism, should have gotten into a closed bone abscess in conjunction with a streptococcus infection. Moreover, this is the only case in which a closed abscess gave a mixed infection. It is possible for these organisms to have remained in the bone, from time of the first operation, but it does not seem likely in view of the rather delicate nature of both organisms. Aureus has been known to remain viable for years, but so far as the writer knows, not albus nor the streptococcus group, which die rather easily. Three aureus abscesses of unknown origin were opened. One of these was inguinal, no injury, no

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urethritis; swelling of two weeks' duration drained; culture, aureus. A second abscess, subfascial, not associated with sore throat nor tonsillitis, was opened at the angle of the jaw and proved to be also aureus. There was no carious bone nor dental caries in connection with this case. The proximity to the mouth suggests a lymphatic course for the infection.

A most interesting case was as follows:

The writer saw in consultation a man fifty-seven years of age with the following history: He had been treated for two weeks by his brother, a physician, for grippe. He had a chill, fever to  $103^{\circ}$ , malaria. Later pain in the right wrist, some swelling, then pain in the region of the right hip, œdema, swelling. An exploring syringe revealed the presence of an abscess under the fascia lata, which was drained, cultured, and proved to be pure aureus. It is difficult to trace the origin of this infection. The patient made a good recovery and never showed any evidence of infection elsewhere. The affected wrist suggests a hæmatogenous origin, but it was not possible to say that there had been an endocarditis, and in view of the extremely fatal character of endocardial infection of the aureus type, the inference is that no endocarditis had preceded the attack.

A somewhat similar case to this treated by the writer occurred in the person of a lady, who for three weeks previous to her coming under the care of the writer, had recurrent attacks of what was diagnosed as Pfeiffer's glandular fever. The attack had also been called grippe. Each of the weekly attacks had been preceded by chill, fever, malaria; the last by some swelling in the neck anterior to the left sternomastoid muscle. This finally proved to be an abscess underneath the deep fascia of the neck and was drained. A streptococcus was cultured from the pus, but was a slow grower, not showing any growth until the fifth day. This lady developed a soft murmur at the aortic orifice, developed septic wrists and knee, had three convulsions, although the urine was negative, but finally recovered after the use of a vaccine which was not autogenous but came from the organism of another patient.

Abscesses occurring in post-typhoid are usually found to contain typhoid bacilli in pure culture. This is not always the case, as the following case shows:

A patient in the fifth week of typhoid, convalescent, developed an abscess at the right wrist, an abscess of the left leg, an abscess in both arms. Cultures taken from these abscesses proved to be aureus, streptococcus, and diphtheroids. From a tubercular sinus of the neck exactly the same organisms were recovered, although the patients were in different wards and under different house officers and nurses. The streptococcus occurred in pure culture 22 times, but was by no means always of equal virulence. In one case after a pin prick, the cellulitis started in a few hours and involved the lymphatics to the shoulder in 48 hours.

One curious case of streptococcic infection was as follows:

A negro came into the writer's service in the Kings County Hospital with a swelling of the axilla and upper arm. His story was that his employer had been operated upon at home for an abscess of the arm and he had cleaned up the room after the operation. The following day he complained of pain and swelling in the right arm and came to the hospital for treatment. The hand was carefully examined for a scratch or abrasion of any kind, but none was discovered, nor was the hand affected at any time, the infection being restricted to the area above the elbow. Drainage showed a pure culture of the streptococcus. Another abscess of the axillary fossa without history of injury or abrasion showed a pure culture of streptococcus in short chains.

The most likely source of contagion in abscesses of this type and in perhaps all subcutaneous abscesses not of traumatic origin is in an infected sweat gland or hair follicle. There was no evidence in any of the cases beyond conjecture that either of these was the starting point of the infection.

Two cases of streptococcic infection occurred in fractures. The first was in the writer's service at St. John's Hospital and was subsequent to the application of a Lane plate for bad oblique over-riding fracture of tibia and fibula, with great displacement. The writer has used the Lane plate in nine cases during the past

winter with good results, except in this case, which he relates in order that it may at least serve as a warning against the indiscriminate use of the open method in this treatment of fractures. The subject of the fracture was a young man of alcoholic habits, who received the injury as a result of an automobile accident. The case was ideal for the open method, as the bones, when reduced could not be held but slid past each other with much over-riding. The operative field was most carefully prepared twice after the usual method. After the patient was in the operating room, the leg was painted with tincture of iodine, which was allowed to dry. Every one connected with the operation wore rubber gloves. There was very little handling of the tibia to which the Lane plate was secured, resulting in perfect apposition. The fascial wound was closed with catgut, the skin with silkworm gut, a dressing applied and a plaster case. The wound showed evidence of infection on the second day and a window was cut in the case, the sutures removed, and pus found which was of streptococcus origin. Every effort was made to trace the error in technic if any. The gauze, the suture and ligature material were tested and the samples taken shown to be sterile. The nasal cavities of every one concerned in the operation were cultured and no streptococci found. There was not another streptococcus case in the hospital, and the writer went straight from the operating room of this hospital to another hospital and did three operations, one a gastro-enterostomy, all of which recovered with primary union. Drs. Avery and Garside of the Hoagland Laboratory made every effort to hunt down the source of contagion but failed. The patient ran the gauntlet of prolonged suppuration, multiple incisions, necrosis, and is now, five months after the operation, just beginning to get union. Was the source of this infection hæmatogenous? In view of the many cases of closed infection which occurred in this series without the intervention of any injury, we cannot absolutely deny the possibility that an operation wound may become infected from within and not from without.

The other streptococcus infection occurred secondarily in a compound fracture of the tibia, which had been wired at the Coney Island Hospital. Three months afterward the attending surgeon did an operation for the removal of some necrosed

bone. This was followed by a rise in temperature and evidences of severe infection. The writer saw the case the week after the operation for necrosis, and on examining the patient's heart found a soft blowing murmur. Diagnosis, septic endocarditis, probably of streptococcic origin. Blood culture showed 100 colonies of streptococci to the cubic centimetre. In spite of treatment by vaccines and antistreptococcic serum this patient died. No cultures were taken from the wound prior to the second operation. The writer desires to make the point that this should have been done, and immunizing doses of the organism found and given prior to the second operation. It is evident that a bacteriological examination of the old wound prior to operation might have served to put the surgeon on his guard and might have avoided a catastrophe.

Seven cases of puerperal infection occurred in this series of cases, of which four were of pure streptococcic origin. In these four cases blood cultures were taken and streptococci recovered as follows:

A. T., January 12. Induced abortion; culture shows long chain streptococci, 200 colonies in 0.5 c.c. of blood; death.

Mrs. E., puerperal sepsis eighth day; blood culture; streptococci in long chains; 12 colonies in 2 c.c. of blood. Culture from cervix streptococci. An autogenous vaccine was made for this case and she recovered but developed a deep abscess of the right hip, subfascial, running in the direction of the thyroid foramen. This was drained, and cultures taken proved to be streptococcic in character. Ten days after drainage she again developed an evening rise in temperature. Careful examination showed no retained pus, no abscess or evidence of inflammatory process in the pelvis. She again received an autogenous vaccine and the temperature fell to normal, after which she recovered. This is the second case of abscess of the upper thigh occurring secondary to a puerperal infection observed by the writer lately. It is possible that it is of lymphatic origin via the lymphatics which accompany the obturator artery and vein into the pelvis.

CASE IV.—Induced abortion six weeks previous. Patient seen by family physician one week after the operation for abor-

tion; temperature  $104^{\circ}$ ; had been told by "operator" that she had grippe. Sepsis six weeks' duration; no phlegmon. Seen then by writer. Marked endocardial murmur. Pelvis clear. Septic wrists and knees, chills; temperature  $102^{\circ}$ – $104^{\circ}$ . Blood culture showed numerous streptococci, colonies not counted. The administration of a polyvalent vaccine (Van Cott's formula) and subsequently an autogenous vaccine followed by a remission of all the symptoms. A week later, however, patient embolized her left middle cerebral and also developed septic infarcts in both lungs and died.

The three cases of mixed infection were as follows:

Peritonitis following abortion. Death. Swabs from peritoneal cavity at autopsy showed streptococci of the large variety, the chains occurring end to end, probably the intestinal streptococci and diphtheroids developing in a very delicate growth on the culture medium.

CASE II.—Mixed infection, puerperal sepsis following delivery by students. *Staphylococcus aureus*, *albus*, and *Streptococcus longus*. Recovery.

CASE III.—Sepsis following delivery; brought to the hospital. No blood culture; vaginal swab showed colon and *albus*. Recovery.

Of these seven cases all were streptococcic in type except one in which only colon and *albus* were found. This was of mild type. Six of the cases were induced abortion.

The pneumococcus in pure culture was usually found in the empyemas, when there was an intercurrent or preceding pneumonia. There were four cases of special interest of pneumococcus infection in cases not empyema.

CASE I.—A. B., Kings County Hospital. Dry pleurisy, right side, followed by a painful swelling at the region of the right sternoclavicular joint which appeared quite rapidly. Pus from the drainage operation showed a pure culture of the pneumococcus.

CASE II.—Pneumococcus infection of the right knee-joint. This was a man in the Kings County Hospital who came into the service after an illness of two weeks. His account was that the right knee became swollen and painful after a fall



which did not bruise the knee or break the skin. Patient thought he had rheumatism. Examination showed a much swollen knee-joint full of fluid; temperature  $101^{\circ}$ – $104^{\circ}$ . Aspiration proved the contained fluid to be pus. Culture showed a pure pneumococcic infection; no pneumonia; no pleurisy. The Mayo operation done for drainage. Pus found to have escaped from the capsule into the intermuscular planes. Attempts to save the limb in vain and patient died.

CASE III.—Compound fracture of the head of the humerus in a stout woman of forty-eight years, Kings County Hospital. Wound enlarged; head and shaft joined by Lane plate. Infection, pneumococcus, drainage. This patient did well for a time, but the arm was subsequently removed at the shoulder for a renewal of the infection by the writer's successor in the service.

CASE IV.—Pneumococcic conjunctivitis, contracted from patient's daughter and when first seen was thought to be of gonorrhœal origin. Cultures showed a pure pneumococcic infection.

All the cases of suppuration in which the pneumococcus was found were of a severe type. The empyemas were classified as follows: those following pneumonias, in all but one of which pure cultures of the pneumococcus were found. In one case, that of a child who came to the hospital with fluid in the right chest, a bronchopneumonia had been present and the cultures from the drainage operation showed aureus and diphtheroids, the former predominating. An empyema said to have followed an attack of influenza was aspirated, but cultures from the aspirated fluid, though this was turbid, remained sterile. Resection of a rib was done for free drainage. Cultures from the drains gave a Gram negative bacillus which proved to be Friedlander. This patient died. The drained fluid was thin and bloody.

An interesting case of encysted empyema was that of a patient, a man fifty years of age, with cough and expectoration suggesting tuberculosis. No tubercle bacilli, however, were ever found in his sputum though frequently sought for, but numerous streptococci. The Von Pirquet reaction was negative.

He developed an encysted pleurisy just posterior to the angle of the scapula, which was drained. Cultures taken from the drainage showed pure streptococci. Although perfectly free drainage had been provided, patient continued to run an evening temperature. Finally he received a vaccine made from his own organism, after which his temperature fell to normal.

Five cases of perinephritic abscess came under the writer's observation and were drained. Four of these were pure aureus, one a colon infection. On the contrary all of five cases of unilateral hæmatogenous infection of the kidney showed pure cultures of the colon bacillus, the cultures being taken from the small abscesses in the renal cortex after hemisection of the kidney, subsequent to the nephrectomy. No deductions can be drawn from a few cases, but one would naturally expect perinephric abscesses to be the result of colon infection rather than aureus, owing to the proximity of the colon. In the infected kidneys, the origin was clearly hæmatogenetic, as the abscesses occupied the location of the vascular tufts. This variety of infection is probably never the result of an ascending infection of the bladder, the symptoms being quite different from and far more severe than a simple pyelitis or even a pyelonephritis.

This short collection of cases is submitted with much diffidence. Yet few in number as are the cases, the labor involved in the isolation of the infecting organisms has been very great and has consumed much time. It is the intention of the writer to continue the work with the assistance and collaboration of the Hoagland Laboratory. In course of time it may be possible to make conclusions of value. It is not impossible that we may find a method of immunizing a patient against infection previous to operation or to sterilize the blood current and tissues after infection has occurred. That is what Ehrlich has done in syphilis.

The writer gratefully acknowledges the assistance of Drs. White, Avery, Garside, and Mr. A. W. Lyall, the bacteriologist to the Long Island College Hospital, without whose aid this work would have been impossible.

# THE ANATOMY OF SPINAL PUNCTURE WITH SOME CONSIDERATIONS ON TECHNIC AND PARALYTIC SEQUELS.\*

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THE topic includes a consideration of the propriety of tapping the spinal arachnoid sac in any region of the cord below the midcervical. For emphasis, *the conclusion from these studies is stated at the very start*, that the only vertebral interspaces through which puncture of the subarachnoid space can be made with practical assurance that nerve structure will not be penetrated, are the fourth lumbar and the lumbosacral, preferably the former. This statement presupposes the employment of a correct technic.

Key and Retzius<sup>1</sup> in 1828 published extensive studies of the subarachnoid space. They injected the subarachnoid space with a blue color fluid and then made frozen sections of the cord. They state that the anterior subarachnoid space of the cord is entirely free and open, but that the posterior space in the dorsal region is divided up by interrupting membranes attached in the lines of the nerve-roots. Their only suggestion of an adhesion between the posterior surface of the cord and the arachnoid membrane is contained in the following words: "At the lowest part of the cord the conditions change essentially. The posterior septum, if we include under this name the posterior arachnoid midmembrane and trabeculæ, is usually very richly developed and contains a number of larger and smaller subarachnoid spaces, at times breaking up into a thick trabecular network which occupies a large portion of, indeed almost the whole, space behind the cord between the nerve-roots" (Key and Retzius, i, p. 91).

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\* Read before the New York Surgical Society, April 26, 1911.

They describe a constant valve-like flap in the upper part of the anterior subarachnoid space between the levels of the second attachment of the ligamentum denticulatum and the fourth cervical nerves, convex upward, which permits a free flow of cerebrospinal fluid from brain to cord in front of the ligamentum denticulatum, but obstructs the free passage of cerebrospinal fluid from cord to brain, within this area. Propping<sup>2</sup> has proposed that the opening and closing of this valve with the falling and rising respectively of the spinal fluid, occasioned by the respiratory movements, by alternating a greater opening for ingress of cerebral fluid to the spinal subarachnoid space, with a smaller opening for egress of the spinal fluid to the cranial subarachnoid space, were causative of an active circulation between cranial and spinal subarachnoid fluids.

Quincke,<sup>3</sup> and Gerstenberg and Hein<sup>4</sup> have made original anatomical studies of the spinal cord. Quincke describes the close contact of the spinal arachnoid with the dura surrounding it, as analogous to the relation between adjacent pleural or peritoneal surfaces. He describes the cauda equina as divided into two lateral halves separated by a mesial cleft from 2 to 5 mm. in width. This corresponds to the variety of distribution of the nerve-roots of the cauda equina found in Dissection C of this article. The conus medullaris in very young children lies lower than in adults. Quincke says in this regard: "In eight cadavers of children up to one year of age I found the end of the conus at the level of the third lumbar vertebra, in children three years old at the level of the second lumbar vertebra—only once in a four-year-old child at the level of the fourth lumbar vertebra."

Gerstenberg and Hein state that the position of the nerve-roots of the cauda equina in the subarachnoid space is variable, sometimes the roots lying close to the posterior and lateral walls and again nearer the anterior wall. They give as the usual condition, that in which the nerve-roots divide into two lateral halves, leaving the anterior wall of the space free. They describe the subarachnoid space of the spinal region above the cauda equina as divided by the garland-shaped ligamentum denticulatum into an anterior portion and a pos-

terior portion, the two portions communicating with each other through the spaces between the concavities of the ligamentum denticulatum and the arachnoid sac. Also they note the presence in this space of a posterior median septum in which are holes affording communication between the two sides. These authors have described the extradural veins within the spinal canal. Venous arcades cross the posterior surface of the dura, underlying the bony arches, so that the main vascular channels posteriorly are out of the line of puncture. Anteriorly these veins, which lie on the posterior surfaces of the bodies of the vertebræ, are much larger and more numerous than the posterior ones. With their condition of distention or of collapse the content of cerebrospinal fluid in the subarachnoid space is regarded to vary.

Magendie<sup>5</sup> connected a tube with an animal's subarachnoid space and saw the cerebrospinal fluid rise and fall in the tube synchronous with the movements of respiration.

Propping brings out the fact that the fat at the intervertebral foramina, which is displaceable, and the peridural veins accommodate the changes of intradural pressure.

The writer has observed that the sizable anterior extradural veins of the lumbar region, which are mesially situated, occupy exclusively the transverse hollows on the posterior surfaces of the bodies of the vertebræ between the projecting upper and lower bony margins, and are separated from the dura by the posterior common ligament of the spine, which bridges over the hollows. Between these transverse hollows, in the mesial area of the spine, the intervertebral disks, together with the lipped margins of the adjacent vertebræ above and below, form projecting surfaces measuring about three-fourths of an inch in a vertical direction, which act as piers to support the posterior common ligament, over which areas there are no sizable vessels. Only over the lateral portions of the posterior surfaces of the bodies of the lumbar vertebræ, just within the line of the intervertebral foramina, do the venous plexuses pass upward and downward in the vertical direction. This anatomy has the following surgical importance: that, since the intervertebral disks are situated in the line of a straight forward puncture between two ad-

jacent lumbar spinous processes, with a mesially directed puncture it would hardly be possible for the most inadvertent operator to pierce any of the anteriorly lying extradural vessels.

The writer presents in this paper his findings in fifteen dissections of the spinal cord, in all of which the anatomy of the cauda equina was studied, and in eleven the portion of the arachnoid membrane in relation with the posterior surface of the cord from the conus medullaris up into the cervical region was carefully dissected.

With the exception of the diagrammatic cross sections, the illustrations in this article are either photographs or drawings from photographs.

Especial pains have been taken to demonstrate by these illustrations the varying relations of the arachnoid membrane to the nerve structures, which relations are all-important in establishing a site of greatest safety for tapping the sub-arachnoid space. Thus localities where the posteriorly lying arachnoid was found adherent to the surface of the cord or to an agglutinated mass of nerve-roots of the cauda equina, would manifestly be unsuitable for puncture.

The writer has located the upper borders of the lumbar pedicles (and the intervertebral disks immediately above them) as corresponding to the levels of the intervals between the posterior extremities of the spinous processes, so that in studying the illustrations, the sites of entrance into the spinal theca of a needle introduced through different lumbar interspaces can be estimated from the situation of the pedicles.

#### PUNCTURE AT AND ABOVE THE LEVEL OF THE CONUS MEDULLARIS (Figs. 1 and 2).

The anatomical findings in the eleven dissections of the arachnoid membrane, from the conus medullaris up into the cervical region, were condemnatory to the procedure of puncture within this area, as one attended with the greatest liability of penetrating the cord.

In the whole 15 dissections, the conus medullaris was 11 times found at the level of the first lumbar vertebra, 3 times

at the level of the junction between the twelfth dorsal and first lumbar vertebræ, and once reached to the lower border of the second lumbar vertebra.

Of the eleven dissections of the arachnoid membrane above the conus, in but three—which included Dissections F (Figs. 14 and 15) and G (Figs. 16 and 17)—was there a complete posterior arachnoid space present all the way up into the cervical region. In all of these three there were at intervals interrupting transverse septa, so that the channel posteriorly was not continuous. However, its lateral com-

FIG. 1.

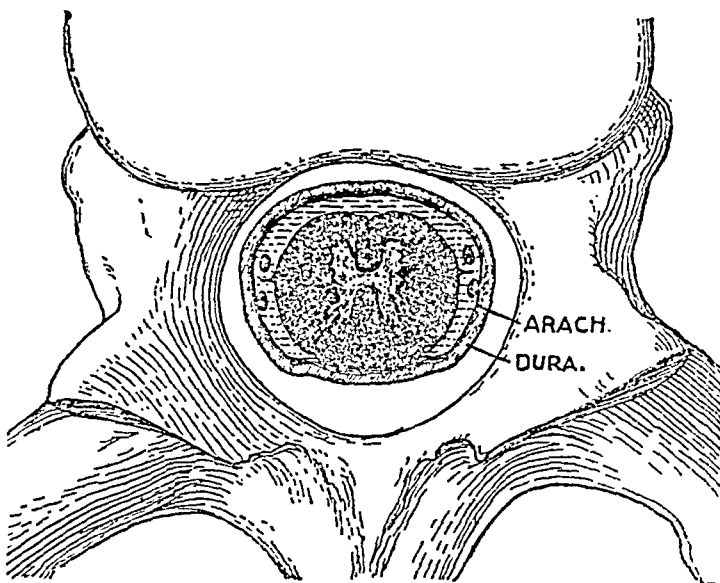


Diagram of a cross section through the dorsal spine, showing how the arachnoid membrane may be adherent to the posterior surface of the cord, which was the predominating anatomical arrangement in this and the lower cervical regions in six out of ten dissections. The close contact between the arachnoid and dura is here illustrated.

munications with the anterior portion of the subarachnoid space over the concavities of the ligamentum denticulatum provided opportunity for a free circulation of the cerebrospinal fluid. In a fourth dissection the posterior arachnoid space was present throughout, excepting for an adhesion of the arachnoid membrane to the cord for an interval of about half an inch opposite the first dorsal vertebra. It, as well, was partitioned by the usual interrupting septa in other situations. In three dissections (including D, Fig. 12, and E, Fig. 13), the arachnoid membrane was adherent to the pos-

terior surface of the cord all the way from the conus up into the cervical region. In one dissection the arachnoid membrane was completely adherent to the posterior surface of the cord above the level of two inches above the conus, in another, above the level of three inches above the conus, and in two others, above the levels of the fifth and seventh dorsal vertebræ respectively. In the last mentioned case the arachnoid membrane was likewise adherent over the anterior surface of the cord from the level of the ninth dorsal vertebra upward into

FIG. 2.

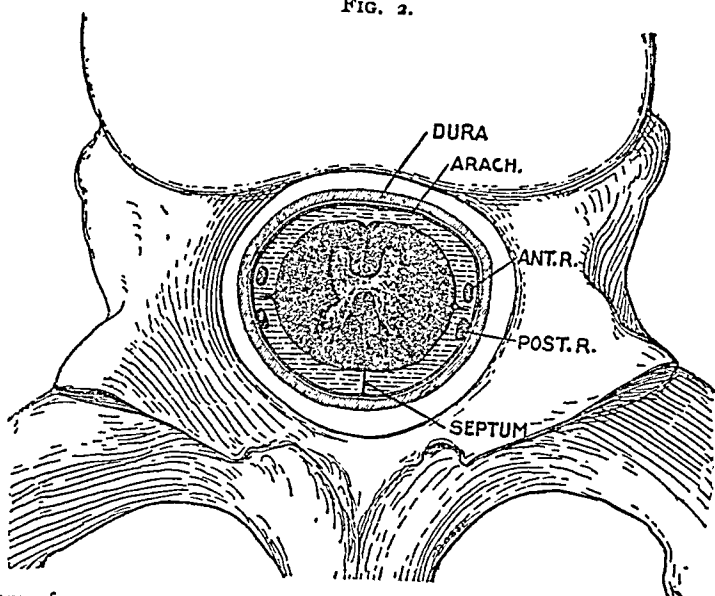


Diagram of a cross section through the dorsal spine, showing how the subarachnoid space may completely surround the cord. An anatomical arrangement of the posterior part of the arachnoid sac, like that here pictured, was found to exist throughout both dorsal and cervical regions in but three out of eleven dissections, and in these the continuity of this posterior part of the channel was interrupted at intervals by transversely lying septa. There is free communication between the anterior and posterior portions of the subarachnoid space through the openings between the concavities of the ligamentum denticulatum and the arachnoid sac. ANT. R., POST. R., nerve-roots.

the cervical region. Laterally in this case, however, the subarachnoid space was open.

The *conclusion* is that if cerebrospinal fluid can be constantly drawn as a result of mesial puncture at or above the level of the conus, in many instances the substance of the cord must be traversed by the needle and the fluid taken from the anterior portion of the subarachnoid space.

*Illustrative of the danger of perforating the cord in tapping the subarachnoid space through the dorsolumbar inter-*



*space*, were the findings in Dissections D and E. In each of these cases, the conus terminated opposite the first lumbar vertebra and there was an adhesion of the arachnoid membrane over its posterior surface. In another one of the dissections, in which the tip of the conus was at the level of the disk between the twelfth dorsal and first lumbar vertebræ, the lumbar arachnoid sac extending free posteriorly only up to the V-shaped outline of the conus, and above becoming adherent to the cord, it would seem quite certain that here, too, to have drawn cerebrospinal fluid as a result of tapping in the dorsolumbar interspace, the needle, which would have been directed about opposite to the tip of the conus, would have had to have penetrated through the nerve structure into the anterior subarachnoid area. In each of eight other of the dissections in which the relations of the arachnoid membrane to the posterior surface of the cord opposite the dorsolumbar interspace were investigated, there was found present in this locality a freely open subarachnoid space, so that in these cases it would have been possible to have punctured the arachnoid sac through this interarcual interval, without injury to the cord.

It is of importance in this connection to consider the work of Rehn,<sup>6</sup> who injected physiological doses of tropacocaine, novocaine, and stovaine into the spinal cords of animals, causing immediate death with typical medullary symptoms. This result occurred regularly, even with diminishing the doses of the drugs to very small amounts. To test whether the effect of these injections was mechanical or toxic, physiological salt solution alone was injected into the spinal cords of animals without any recognizable effects.

A review of some of the cases in which sudden death has occurred soon after the injection of a spinal anæsthetic would embellish this trend of thought.

Especially pertinent are those cases in which the puncture was made in the dorsolumbar interspace. Such cases are, however, few, owing to an almost general obedience to Quincke's precept early laid down, that spinal puncture should be made only below the level of the conus medullaris. Also

of interest in this connection are deaths under spinal anæsthesia, for which definite pathological lesions were found at autopsy to have been accountable.

Cases associated with high pelvic elevation, in which, probably from the heavy specific gravity of the solution used, or from a shifting of the spinal fluid cranialwards, the respiration has become paralyzed beyond the power of restoration, have been here omitted as irrelevant.

*Fatalities During Operations Under Spinal Anæsthesia, Other than Cases of Respiratory Paralysis Associated with High Pelvic Elevation.*

(a) *Where dorsolumbar puncture had been made.*

MILWARD (F. VICTOR): *Death under spinal anæsthesia by Jonnesco's method in a case of acute intestinal obstruction. British Medical Journal, March 26, 1910, p. 743.*

Intestinal obstruction. Injection of 10 cg. of stovaine and 1 mg. of strychnine in 1 c.c. of water between the eleventh and twelfth dorsal vertebræ. Head raised on a thick pillow. In 7 minutes the pupils were dilating and the pulse commenced to fail. Vomited. In 10 minutes patient quite unconscious—gasping respiration and profuse vomiting. In 12 minutes the pulse was imperceptible and the respirations had ceased. Autopsy: The blood-vessels of the surface of the cord over the lumbar enlargement were engorged. The cord appeared not to have been touched by the needle and macroscopically its structure was normal. No hemorrhage observed inside the spinal theca.

GABBETT: *British Medical Journal, March 26, 1910, p. 690.*

Age 40. Elephantiasis of scrotum. Puncture between the twelfth dorsal and first lumbar vertebræ, from which the spinal fluid flowed freely. Ten cg. of novocaine and 1 mg. of strychnine hydrochloride injected. The patient sat up for 1 minute and then laid down with his head on a low pillow. In 5 minutes he was anæsthetic to the level of the nipples and in 10 minutes almost to the level of the clavicles. The patient died of respiratory failure within half an hour.

(b) *Where death was due to a cause other than the spinal anæsthetic.*

BONDY: *Ueber das post-operative Verhalten nach Lumbal-anæsthesia. Gyn. Rundschau, iv, 1910, p. 99.*

The patient had a systolic murmur with a striking cyanosis of the face. Five minutes after the injection before the elevation of the pelvis the patient died. Autopsy: embolus left pulmonary artery.

HOHMEIER: *Hohmeier u. König. Verhandl. d. deuts. Ges. f. Chir., xxxix, 1910, p. 481. Sammelforschung über die Lumbalanæsthesie im Jahre 1909.*

In a collection of 2400 cases from 41 institutions in the year 1909, there was one patient suffering from arteriosclerosis who died 10 minutes

after the injection of the spinal anæsthetic from cerebral apoplexy. There was adrenalin in the injecting fluid.

(c) *Other cases.*

DÖNITZ: *Wie vermeidet man Misserfolge bei der Lumbalanæsthesie.* Münch. med. Wchsft., 1906, p. 1338.

The following was the first case of death caused by the anæsthetic in more than 1000 cases of lumbar anæsthesia in Bier's clinic:

Age 75. Carcinoma of penis. 0.13 g. tropacocaine diluted with 10 c.c. of spinal fluid injected between the second and third lumbar vertebræ in the sitting position. The patient was then laid flat, the anæsthetic rapidly extended to the neck, and in a few minutes the breathing and pulse stopped. Autopsy: brain and spinal cord showed nothing special. Death regarded to be due to the large dose of tropacocaine.

VEIT: *Bruns Beiträge z. kl. Chir.*, liii, p. 751.

Age 63. Enlarged prostate. After having been successfully subjected to novocaine spinal anæsthesia on the sixth and third previous days, there was administered a lumbar injection of 0.07 g. stovaine. Three minutes after the injection the patient suddenly became pale and the pulse and breathing stopped. Autopsy: small hemorrhage at the site of puncture within the dural sac. No macroscopic changes in the cord throughout its entire course. Veit states elsewhere that he always punctured between the second and third or the third and fourth lumbar vertebræ.

REHN: *Ueber Rückenmarksanæsthesie.* Mitteil. a. d. Grenzgeb. der Med. u. Chir., xix, 1908-9, p. 806.

(a) Quotes the results of Körte, who in 180 cases of lumbar anæsthesia had one death attributable to the anæsthetic. Woman, age 71. Incarcerated femoral hernia. Pulse 88. 0.05 g. alypin with adrenalin administered by lumbar puncture. No pelvic elevation. Forty minutes after the injection collapse and death. Autopsy: the cord was without pathological changes.

(b) Quotes the results of Brentano, who in 99 cases experienced one death from the anæsthetic as follows: Age 75. Irreducible umbilical hernia. 0.04 g. alypin with suprarenin injected between the second and third lumbar vertebræ. Clear fluid was first drawn. Very slight pelvic elevation. In 10 minutes the pulse and respiration became irregular and in 30 minutes the patient died. Autopsy: no cause for the sudden death.

(c) Reports out of 30 cases at the Charlottenberg Western Hospital, 1 death, as follows: Woman, age 79. Ileus from inoperable rectal carcinoma. Slow strong pulse. After the injection of novococaine suprarenin a small cushion was put under the hips. In 10 minutes the patient became pale and vomited and the pulse slowed. Cushion immediately removed but the patient died in another 10 minutes.

HOHMEIER U. KÖNIG: *Sammelforschung über die Lumbalanæsthesie im Jahre 1909.* Verhandl. d. deuts. Ges. f. Chir., xxxix, 1910, p. 481.

Out of 12 deaths in 2400 cases of lumbar anæsthesia collected from 41 institutions, due to the spinal anæsthetic, 4 were due to respiratory

paralysis occurring shortly after the injection. Hohmeier says: "In such cases autopsy gives no clue to the cause of death, neither macroscopic nor microscopic changes being found."

KÖNIG: *Sammelforschung über die Lumbalanæsthesie im Jahre 1909, Hohmeier u. König. Verhandl. d. deuts. Ges. f. Chir., xxxix, 1910, p. 481.*

Age 60. Intracapsular fracture of femur. Three novococaine Höchst tablets used for injection. "In 5 minutes the anæsthesia was up to the navel and in 10 minutes asphyxia supervened, and in spite of all effort to resuscitate the patient she could not be saved."

BONDY: *Ueber das post-operative Verhalten nach Lumbalanæsthesia. Gyn. Rundschau, iv, 1910, p. 99.*

(a.) Woman. Osteomalacia. Three days post partum. In good condition. Ten minutes after the injection stopped breathing and died. Autopsy: œdema of the brain; cystitis; pyonephritis.

(b) Cæsarean section. Five minutes after the injection, before raising the hips high, the patient died of respiratory paralysis. Autopsy: gave no cause for death.

Bondy had 3 deaths in 1000 cases attributable to the spinal anæsthetic.

MICHELSSON: *Ein Beitrag z. Lumbalanæsthesie mit stovain-Billon. Arch. f. kl. Chir., xcii, 1910, 657-724.*

Age 37. Pyloric stenosis. 0.056 g. stovaine. Also morphine 0.01 and scopolamine 0.0005. The horizontal posture was maintained. After 5 minutes there was satisfactory anæsthesia to the ensiform cartilage. On presenting the stomach there was sudden collapse and death.

Michelsson out of 400 cases of lumbar anæsthesia had 4 deaths attributable to the anæsthesia.

SELLHEIM: *Ueber Geschichte, Anatomie, und Technik der Rückenmarksanæsthesie. Medizinische Klinik, 1910, vi, p. 5.*

Out of 1000 cases of major gynæcological operations done under spinal anæsthesia he reports one death which could be chargeable to the anæsthetic. The case was one of proposed Cæsarean section who died before the *Kaiser schnitt* could be undertaken.

#### PUNCTURE BELOW THE LEVEL OF THE CONUS MEDULLARIS.

*Arrangement of the Nerve-roots of the Cauda Equina.*—While the distribution of the nerve-roots of the cauda equina within the arachnoid sac was found to vary considerably, their general order of arrangement with relation to one another was found to be uniform, which latter fact it can be seen would be necessarily so, in that the nerve-roots arise serially from the conus medullaris and pass downward in regular order to their fixed foramina of exit arranged in a vertical row on either side of the spinal canal. Thus the first lumbar root has the most lateral and highest origin from the conus medullaris. The root passing through the second lumbar foramen of exit takes its origin from the conus medul-

laris next below the first root, and so on down the whole series until from the apex of the conus the lowest sacral nerve-roots arise, which in natural order occupy the most mesial position of all the nerve-roots, either lying in close relationship with, or, in cases where there is a cleft, diverging a little from, the median sagittal plane. The mesial position of the lowest sacral nerve-roots would render them the most liable of any to injury in median lumbar puncture, traumatism to which could be offered in explanation of those cases of paralysis of the bladder and sphincters which have followed lumbar puncture.

Where the nerve-roots of the cauda equina lay together in masses they did not individually float free in the cerebrospinal fluid, but were bound closely together by delicate adhesions, which, though they could be broken apart with the use of almost no force at all, were nevertheless strong enough to hold the roots together as one solid impermeable structure. Occasionally the nerve-roots were found to float free but only in the lower part of the subarachnoid space, below where the main mass had been distributed. Thus the lower nerve-roots of the cauda equina in Dissection B (Fig. 7) were separate and free, as were also the nerve-roots from the lower lumbar region downward in one of the dissections of Type I not here illustrated.

*The Sacral Leverage.*—The sacrum, projecting posteriorly from its site of articulation with the lumbar portion of the spinal column, when forced downward has the action of a lever of the second order on resisting structures attached to its upper surface at a sufficient distance from the point of fulcrumage. The sacral nerve-roots may, under certain conditions, constitute such resisting structures in relation to the sacral lever. Thus when the subarachnoid space extends far enough downward into the sacral canal and is at the same time of sufficient calibre to allow those nerve-roots which are fixed to the projecting portion of the sacrum to have free play, and when at the same time these nerve-roots are not too slack (cf. Fig. 13) to furnish resistance to the downward forced sacrum, it can be seen that descent of the sacral lever

will make these sacral nerve-roots taut, in effecting which, owing to the posterior projection of the sacrum, the same movement will, as well, carry the nerve-roots backward out of the lumbosacral hollow into a more posterior position (cf. Figs. 6, 7, 8, and 16).

The first sacral vertebra projects but little posteriorly and that chiefly at its base, above which latter the first sacral nerve-roots diverge to go to their lateral openings, so that these nerve-roots are attached too close to the fulcrum to be much if at all influenced by the sacral leverage. The bodies of the second and third sacral vertebræ are the ones which do project markedly backward, so that when a sub-arachnoid space of good calibre extends down to the base of one or the other of these vertebræ, allowing more or less opportunity for free play to those nerve-roots attached to the sacrum well behind the fulcrum, then it is that these nerve-roots, if of a length shorter than that of the lumbosacral curve in the descended position of the sacral lever, will come under the latter's influence. It was found that only extreme descent of the sacral lever could make the sacral nerve-roots taut. In the erect position of the body consequently, in which the pelvis is tilted well backward, the sacral nerves would be relaxed.

The sacral lever descends with the forward tilting of the pelvis which occurs in extreme lumbar flexion, in which position, therefore, in the presence of the conditions named, the mesially lying sacral nerve-roots will become taut and be carried posteriorly (Fig. 8). Conversely, when the pelvis is tilted backward the sacral nerve-roots are relaxed, and in extreme extension of both sacrum and lumbar column as well, all the nerve-roots of the cauda equina are thrown into a state of relaxation (Fig. 9). Therefore in lumbar puncture, it would seem of the utmost importance that the posture of election should be one in which the pelvis is not allowed to tilt forward, so as to be sure of securing relaxation of the mesially lying sacral nerve-roots, on the principle that a relaxed nerve-root is less likely to become impaled upon the point of the puncturing needle than is a tense one. Also

FIG. 3.

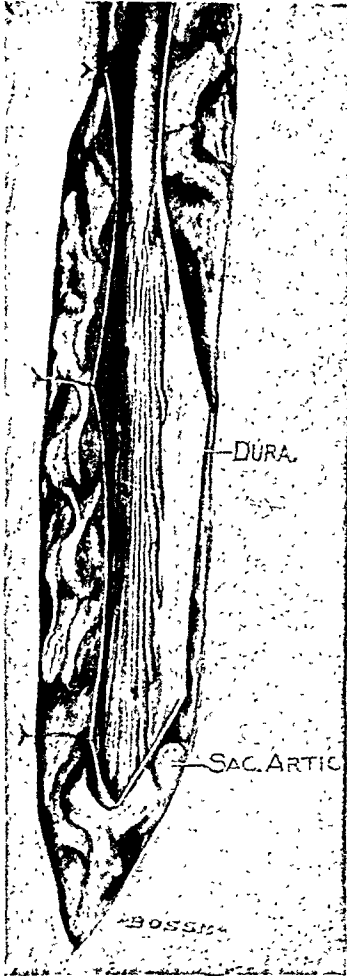


FIG. 4.

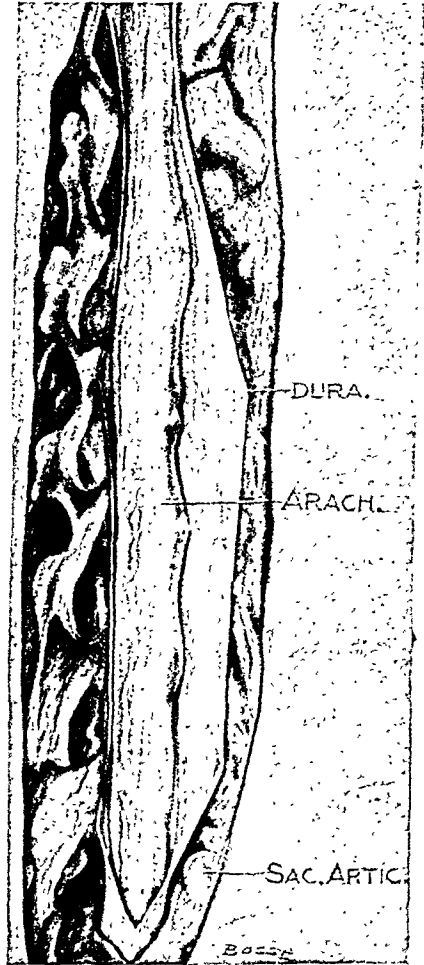


FIG. 3.—Dissection A, Type I (most frequent, 46.6 per cent.). The nerve-roots of the cauda equina, being connected together by delicate adhesions, form a flattened ribbon-like mass which occupies an anterior position in the arachnoid sac (cf. Fig. 5) and is attached on either side by the nerve-roots at their sites of exit, as well as by the adhesion of the same to the arachnoid membrane where they take a lateral position before gaining exit. In this type the positions of the sacral nerve-roots are not altered by extreme lumbar flexion (see "sacral leverage," p. 459). The delicate transparent arachnoid membrane here lay invisible, covering the nerve-roots. SAC. ARTIC., sacral articulation.

FIG. 4.—Dissection A, Type I. Shows the arachnoid membrane, unseen in Fig. 3, now inflated with air. There are no nerves in relation with its posterior aspect (cf. Fig. 5), and puncture in this case could have been made safely by a direct lateral as well as by the median route through any one of the lumbar interspaces. In contrast, see Fig. 13.





when relaxed by posture, these nerve-roots if free from arachnoid attachment are capable of taking a more anterior position in the subarachnoid space than when they are taut (Figs. 9 and 11).

Downward forcing of the sacral lever produced no tension on the sacral nerve-roots in the dissections of Type I, in which the nerve-roots of the cauda equina lay bound together in a flattened mass situated anteriorly in the subarachnoid space, nor in the Dissections E (Fig. 13) or F (Fig. 14), in which latter two the nerve-roots were of too great a length to offer any resistance to the descended sacrum. Of Type I, five of the dissections were examined to investigate the reasons for the absence of the action of the sacral leverage upon the sacral nerves, and there were found the following anatomical variations to explain the condition: in three of the cases the subarachnoid space did not extend below the level of the first sacral vertebra, which, as stated, exercises practically no leverage upon the first sacral nerve-roots, and the nerve-roots below the first sacral were bound down to the sacral bodies, so that, being consequently of a length equal to that of the lumbosacral curve they moved in unison with the sacrum, and could exercise no restraint upon its descent. In each of the two remaining dissections of Type I, the subarachnoid space extended down as far as to the lower border of the body of the second sacral vertebra, but in both the nerve-roots were evidently too long to receive the pull of the descended sacrum, and in one of these the dural sheath over the second sacral vertebra was of such small calibre as practically to simulate the anatomical arrangement where the nerve-roots over this area were bound down to the sacrum.

*Classification of the Caudæ Equinæ.*—The caudæ equinæ of the 15 dissections have been classified according to the variation in distribution of their nerve-roots, into five different types, the points of differentiation among which are all amply noted in the legends of the illustrations.

TYPE I (Figs. 3, 4, and 5) was the most frequent, it having been found 7 times in the 15 dissections, or in 46.6 per cent.

In this type the nerve-roots of the cauda equina lay massed together against the anterior wall of the arachnoid sac, and the position of the sacral nerve-roots was uninfluenced by the descent of the sacral lever. The evident reasons for the latter result have already been given (see above, "sacral-leverage"). One other dissection of the series was pre-eminently of this same type, but it presented this variation from the normal, that three aberrant nerve-roots came into relation with the posterior part of the arachnoid sac to which they were adherent. This dissection, therefore, presenting features that might lead to surgical complications similar to those that could arise in a case like that

FIG. 5.

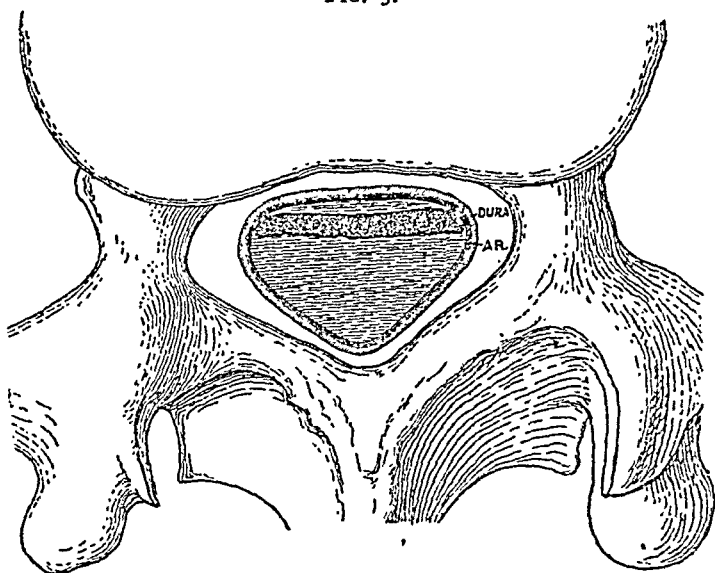


Diagram of cross section of Dissection A (Figs. 3 and 4). The nerve-roots, joined together by delicate connective tissue, lie in a flattened mass anteriorly situated in the arachnoid sac, to which latter the laterally lying nerve-roots before taking their exits are adherent.

shown in Figs. 14 and 15 (Dissection F) has been classified with the latter dissection as an example of Type IV.

In four of the dissections of this type observations were made as to the heights to which the arachnoid membranes extended upward from the lumbar sacculation free from adhesion to the posterior surfaces of the nerve structures, and it was found that once the posterior sacculation extended to the conus, once to two inches above the conus, and that in the other two cases the arachnoid membrane was for the most part free all the way up the cord excepting for the occasional transverse septal interruptions.

FIG. 6.

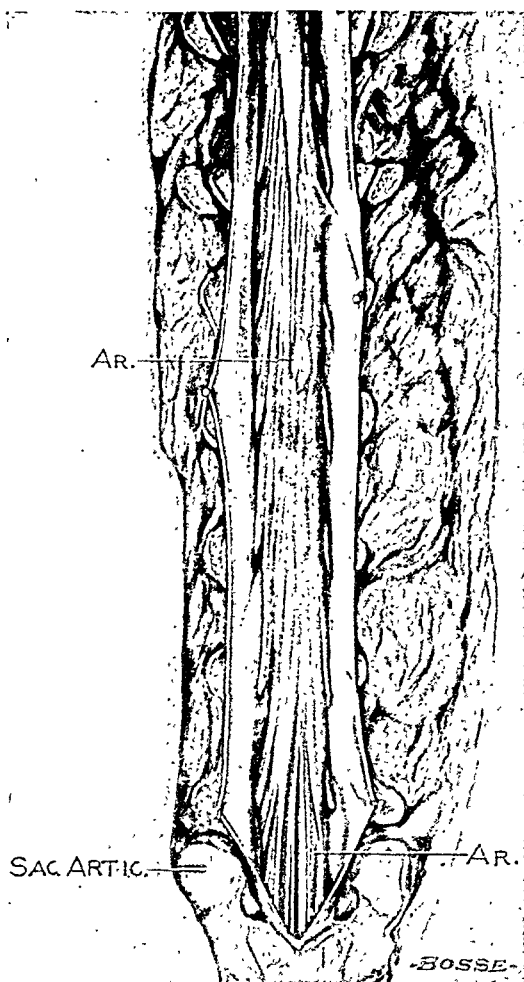


FIG. 7.

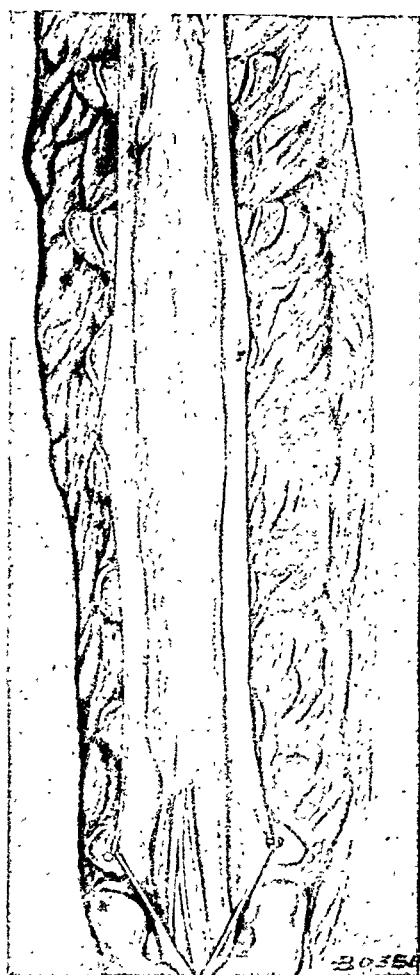


FIG. 6.—Dissection B, Type II (13.2 per cent.). This is a modification of Type I. Similar to Type I was that portion of the cauda equina above the fourth lumbar vertebra where the nerve-roots lay flat against the front of the subarachnoid space in all positions of the spine, but differing from Type I was the portion below the level of the upper edge of the fourth lumbar vertebra, where the sacral nerve-roots, by an extreme downward movement of the sacral lever, would be made taut and drawn backward so as to span the lumbosacral hollow. The subarachnoid cavity here extended downward to well over the third sacral vertebra. AR., arachnoid membrane, which is transparent, overlying the nerve-roots. Above, this membrane was lifted by an air bubble.

FIG. 7.—Dissection B, Type II. Air inflation of subarachnoid space. The air inflation could not here so certainly have reproduced the normal relation of the sacral nerve-roots to the arachnoid membrane as could have a water distention, since the close contact between these structures as here pictured was found to have been the result of a postmortem agglutination. With the introduction of water to test the fixity of the sacral roots, and at the same time raising the sacral lever to relax the same, the latter fell away from their contact with the arachnoid membrane. The sacral nerve-roots of this dissection would become relaxed in the erect position of the body.



In this type it can be seen that a straight, forward puncture into the subarachnoid space just lateral to the median line, made below the level of the conus, would encounter no nerves, yet, for the greatest safety to the patient, the needle should nevertheless be directed toward the median line, and, as well, introduced through one of the two lower spaces only, in order to anticipate the possibility of encountering an anatomical condition such as that illustrated in Fig. 13.

TYPE II (Figs. 6 and 7).—Of this type there were two specimens (13.3 per cent.). This type is a modification of Type I, the distinguishing feature being that in Type II the action of the sacral leverage on the mesially lying sacral nerve-roots raises the latter posteriorly out of the lumbosacral hollow. With sacral extension, which relaxes the sacral nerve-roots, this type practically assumes the anatomical picture of Type I. In the specimen of Type II not here illustrated, the arachnoid sac terminated opposite the middle of the second sacral vertebra, and its lower half inch was narrowed around the nerve-roots, so that, being held rather closely to the projecting portion of the sacrum, the sacral nerve-roots could come but little under the influence of the sacral leverage, and consequently the extent to which they could be raised out of the lumbosacral hollow by the action of the latter was but slight. In the same dissection, opposite the fourth lumbar interspace the mesially lying nerve-roots were connected to the posterior wall of the arachnoid sac by one-quarter inch long trabeculæ, and below this level by trabeculæ diminishing in length, until, just within the sacral canal, these roots became adherent to the arachnoid sac, which finding would seem to be in evidence of a shallowness of this lower portion of the subarachnoid space. Higher, these trabeculæ became fewer and of half-inch lengths. In this case the fourth lumbar interspace, opposite to which the trabeculæ were longer than at any level below, would manifestly have been preferable to the lumbosacral interspace for performing puncture.

TYPE III (20 per cent.) (Figs. 8 to 13) included those cases in which there was a more or less high division of the cauda equina into two lateral halves. In this type the height of the bifurcation and the relations of the arachnoid membrane to the nerve-roots presented considerable variation (Dissections C, D, and E), yielding most interesting information regarding the dangers surrounding the operation of lumbar puncture. The

arachnoid sac in these dissections varied from a condition of complete freedom from any adhesion posteriorly to nerve-roots (Fig. 10), to one (Fig. 13) in which it was adherent to very nearly the whole posterior surface of the nerve-roots of the cauda equina, the roots in which latter case, excepting for a sizable cleft situated mesially below the level of the upper part of the fourth lumbar vertebra, formed one solid agglutinated mass. Also in the latter dissection the arachnoid membrane was attached around nearly the entire periphery of the cleft, which it bridged over, forming a window through which alone puncture into the subarachnoid space could have been effected without having to traverse the mass of nerve-roots. This dissection was the one in the series which gave emphasis to the imperativeness of a mesial entrance of the needle into the subarachnoid space in lumbar puncture, as well as demonstrated the possible danger from puncturing at a level higher than the fourth lumbar interspace.

The results of tensing and relaxing the sacral nerve-roots in this type, by descent and elevation respectively of the sacral lever, are demonstrated in the illustrations (see "sacral leverage," p. 459). Where in this type the posterior wall of the arachnoid sac is free and the subarachnoid space ample behind the nerve-roots (Fig. 10), tension on the mesially lying nerve-roots would evidently be of no import unless the needle point penetrated to the depth at which the nerves lay. Then, it can be seen that a relaxed nerve (Figs. 9 and 11) would be less liable to become impaled than would a tensed one, its mobility enabling it to elude the needle point unless pinioned by the latter against the anterior wall of the spinal canal. The relaxed nerves, with a water content of the sac, gravitated dependently from their sites of attachment, so that the positions they would assume in the subarachnoid cavity of living man would doubtless vary with the posture of the body. In the dissection shown in Fig. 13, the sacral nerve-roots were of too great length to be made taut by the descent of the sacral lever. In this dissection it can be seen that the normal fixation of the nerve mass on either side, together with the support of the sac's walls by its fluid content, must maintain the mesial position of the cleft.

The water was introduced into the subarachnoid space in the dissection illustrated in Fig. 10, through the foramen magnum.

TYPE IV (13.3 per cent.) (Figs. 14 and 15).—The charac-

FIG. 8.



Dissection C, Type III (20 per cent.). In this type the caudal plexus has a more or less high division into two lateral halves. Here the division was at the conus (cf. Figs. 10 and 13). The photograph shows the nerves made taut by the position of extreme lumbar flexion, thereby bringing into prominence the median cleft. The particular influence in making taut the mesially lying nerve-roots, which are the sacral roots, is due to the descent of the sacral lever (see "sacral leverage," p. 459).

FIG. 9.



FIG. 10.

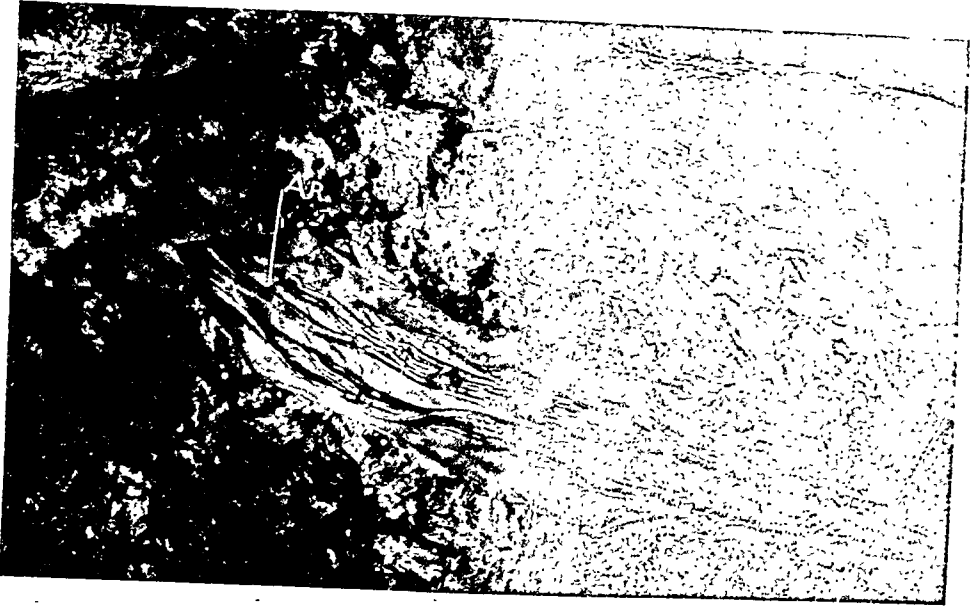


FIG. 9.—Dissection C, Type III. Photograph showing how the nerves of the cauda equina in this dissection, seen in Fig. 8 to have been made tense in the position of extreme lumbar flexion, all became relaxed by the position of extreme lumbar extension. It is the relaxation more especially of the mesially lying sacral nerve-roots that comes up for consideration in lumbar puncture, and this can be gained simply by elevation of the sacral lever which is produced by a backward tilting of the pelvis.

FIG. 10.—Dissection C, Type III. Photograph of water distention of the arachnoid sac of this dissection. The position is that of extreme lumbar flexion, the same as in Fig. 8. Some of the nerves can be seen through the fluid in the lower part of the sac. The tensed nerves lay well away from the posterior surface of the arachnoid sac, which here looks to be more distended than it normally would have been with the support of the intact dura, showing the probable redundancy of this membrane. The fifth lumbar vertebra is *in situ*. A subarachnoid space was continued upward behind the cord from the lumbar region to a level about three inches above the apex of the conus, above which the arachnoid membrane was adherent to the posterior surface of the cord all the way up to the upper cervical region.



FIG. II.



Dissection C, Type III. Photograph of this dissection in lumbar extension to relax the nerve-roots, the body lying on the side with hips slightly elevated. The shoulder girdle had been removed, which gave an abnormal obliquity to the dorsal spine. The picture shows in what manner relaxed nerve-roots of the cauda equina, free from arachnoid attachment, can gravitate. The higher situated half of the cauda equina hangs dependently from its site of attachment along the line of the foramina of exit of its nerve-roots, in which position it lies against the anterior surface of the arachnoid sac. The lower situated half sags into the dependent lateral curve of the arachnoid sac.



FIG. 12.—Dissection D, Type III. The practical site of division of the cauda equina into two lateral halves was here originally at about the level of the second lumbar interspace, the arachnoid membrane having, before its severance, bound closely together the nerve masses of the two sides down to this level. AR indicates the lower level of adhesion of the posterior wall of the arachnoid sac to the nerve-roots, which was also the upper limit of the original cleft. Above this level, with water distention of the subarachnoid space, the nerve-roots were lifted posteriorly by the fluid, but below, the now free arachnoid sac was lifted by the water well behind the nerves. Here, puncture as low as between the second and third lumbar vertebrae would have passed through the mass of nerve-roots, but in the lower three interarcual spaces puncture could have been safely made. The position is that of extreme lumbar flexion, which here tensed the sacral nerve-roots, raising them posteriorly. With the spine upright or slightly flexed, the lateral halves of the cauda equina maintained a forward position against the anterior wall of the arachnoid sac. The arachnoid membrane was adherent to the posterior surface of the spinal cord practically all the way up into the cervical region. ILL. PED., second lumbar pedicle.

FIG. 13.—Dissection E, Type III. This dissection was the one in the series which gave emphasis to the imperative necessity of a mesial entrance of the needle into the subarachnoid space in lumbar puncture, as well as demonstrated the possible danger in puncturing at a level higher than the fourth lumbar interspace. The posterior wall of the lumbar arachnoid sac, excepting that part of it outlined in white, which is here shown laid open, was adherent everywhere to the cauda equina. Thus most of the subarachnoid space lay entirely in front of the cauda equina. Since the fluid in the subarachnoid space in consequence of this anatomical arrangement must have lifted the cauda equina into a posterior position, it would be questionable whether the nerve-roots could have occurred. However in the lower part of this area, the mesial cleft, which was present below the upper border of the fourth lumbar vertebra, and to nearly the entire margin of which the arachnoid was adherent, furnished a situation for unobstructed entrance of a needle into the subarachnoid space. Hence, a puncture free from nerve entanglement could here have been made only through the fourth lumbar or the lumbosacral interspace, with the needle directed mesially. The width of the cleft was not essentially altered by the division of the arachnoid membrane. The photograph was taken from their contact with the lumbosacral hollow, this notwithstanding the fact that the subarachnoid space extended down to the third sacral vertebra. The arachnoid membrane was adherent to the posterior surface of the spinal cord all the way up into the cervical region.

teristic feature of this type was a peripheral distribution of the nerve-roots of the cauda equina around the walls of the arachnoid sac, with adhesion of the roots to the latter. Besides the Dissection F illustrated in Figs. 14 and 15, another of the dissections was classified as one of this type, which had pre-eminently the anatomical characteristics of Type I, but presented this variation therefrom which was characteristic of Type IV, that three aberrant nerves came into relation with the posterior part of the arachnoid membrane, to which they were adherent. Two of

FIG. 15.

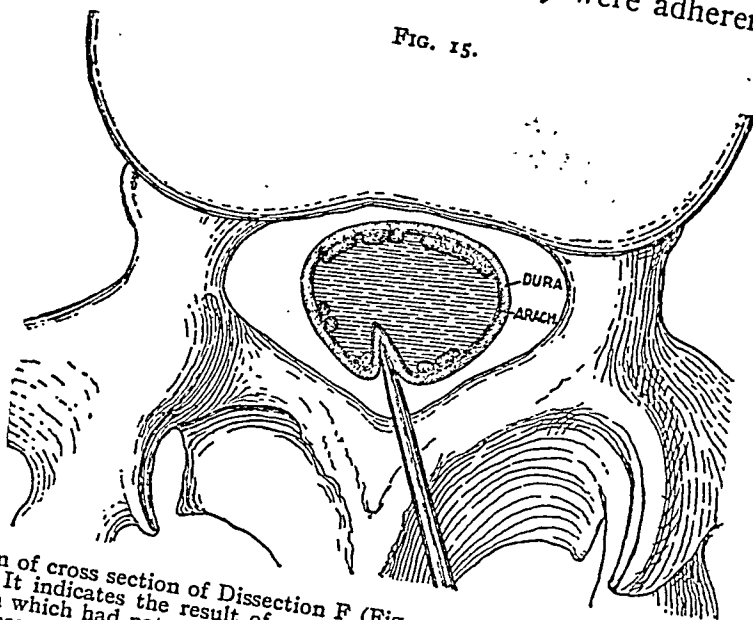


Diagram of cross section of Dissection F (Fig. 14, Type IV) at level of fourth lumbar interspace. It indicates the result of an effort made to injure these nerve-roots with a short hat pin which had not a sharply pricking point, directed against them from without the dura, subsequent to opening the spinal theca. When the dural flap, held by forceps, was allowed to yield a little before the pressure of the puncturing agent, repeatedly the latter would drive before it a wedge of dura, cleaving therewith a path between the nerve-roots, which would recede on either side of the wedge to places of safety before the membrane gave way. Only when the dural flap was drawn very taut by the holding forceps did it seem possible for the hat pin to prick the underlying nerve, which it would then carry inward on its point.

these nerves, running parallel and near together, formed loops bowing backward to near the median line opposite the third lumbar vertebra, and the other, a fine nerve filament, passed around posteriorly from the front opposite the fourth lumbar vertebra to a position near the median line. An effort to prick these nerves with a hatpin having not too sharp a point, directed against them from without the dura after the membranes had been opened, resulted in the slipping of the nerves out of the way, the same as occurred when this test was practised on the nerve-roots of Dissection F (see legend, Fig. 15).

The picking up in the line of puncture of a nerve-root

attached to the arachnoid membrane, such as those found in the dissections of this type, on the extremity of a needle with a sharply pricking point might help explain those cases in which, on subarachnoid puncture, the flow of cerebrospinal fluid through the needle comes slowly in drops from evident partial obstruction of its calibre. The practical experience in the case of these dissections with the hatpin (see legend, Fig. 15) would argue in favor of the use of a puncturing needle without a sharply pricking point. The sacral nerve-roots in Dissection F were not made taut by the descent of the sacral lever.

TYPE V (Figs. 16 and 17).—The cauda equina here consisted of a flattened central stalk from which the nerve-roots, bound together in ribbon-like bands, diverged. The nerve mass arched transversely backward within the subarachnoid space. It can be seen in this dissection how it would be of the utmost importance to relax the sacral nerve bands before introducing a needle into the subarachnoid space. With the mesially lying nerve bands relaxed, from a knowledge of the presence of trabeculæ between the posterior wall of the arachnoid sac and the nerve bands underlying it, of a length of about one-quarter inch, it can be estimated that a needle could pass within the subarachnoid space for a depth equal to this figure before nerve structure would be touched. With deeper penetration, a needle having a sharply pricking point would then probably pick up the relaxed nerve bundle, thereby partially obstructing its calibre, while a needle having a dulled point would be more likely to push the nerve structure before it or pass around the side of the same. With, on the other hand, the mesially lying nerve bands made taut by forcing the sacral lever downward, it can readily be seen that it is quite possible for these bands to be drawn backward closely against the arachnoid membrane, in which event they would almost surely be pierced by the puncturing needle. Or supposing that, even in their tensed position, the full fluid space behind these bands should be still preserved, they would nevertheless be very liable to receive injury, from the fact of their being held rigidly, without any opportunity to yield or swerve.

The impalement of nerve structure on the point of the puncturing needle, in a type of cauda equina of this sort, might also be held accountable for slow dropping of the cerebrospinal fluid, as well as in the case of Type IV.

FIG. 14.

FIG. 16.

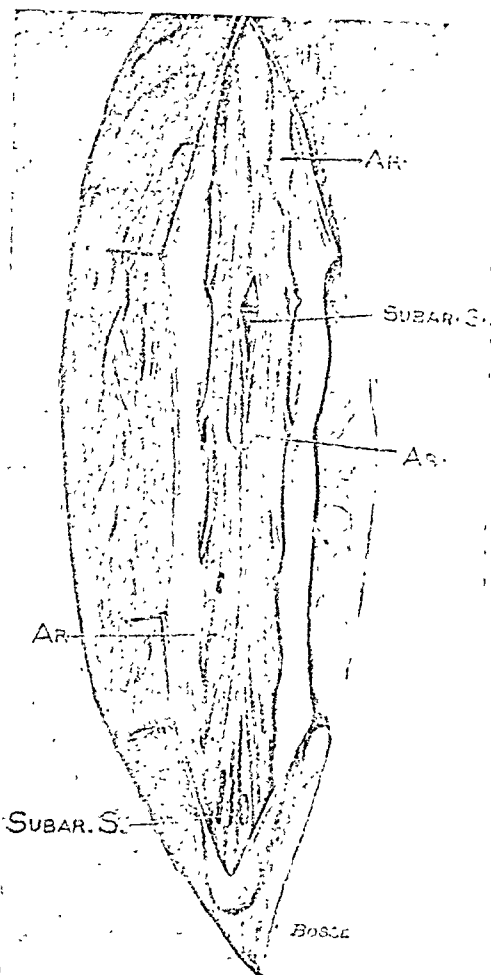
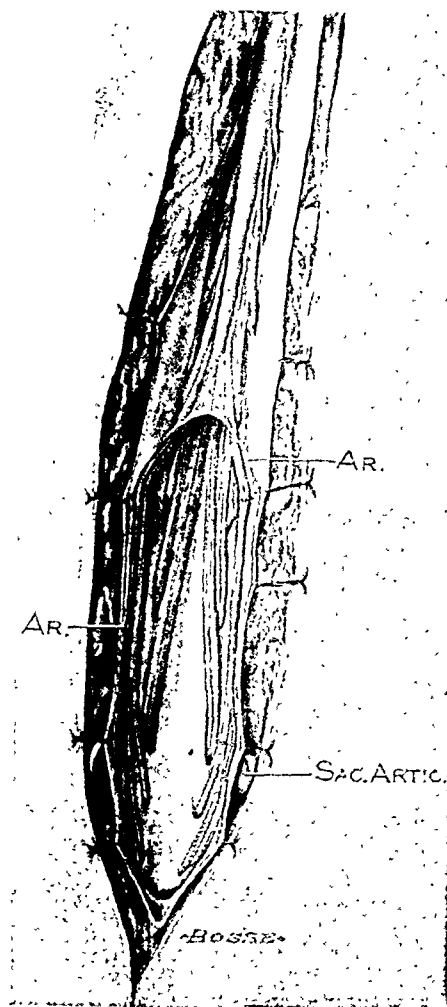
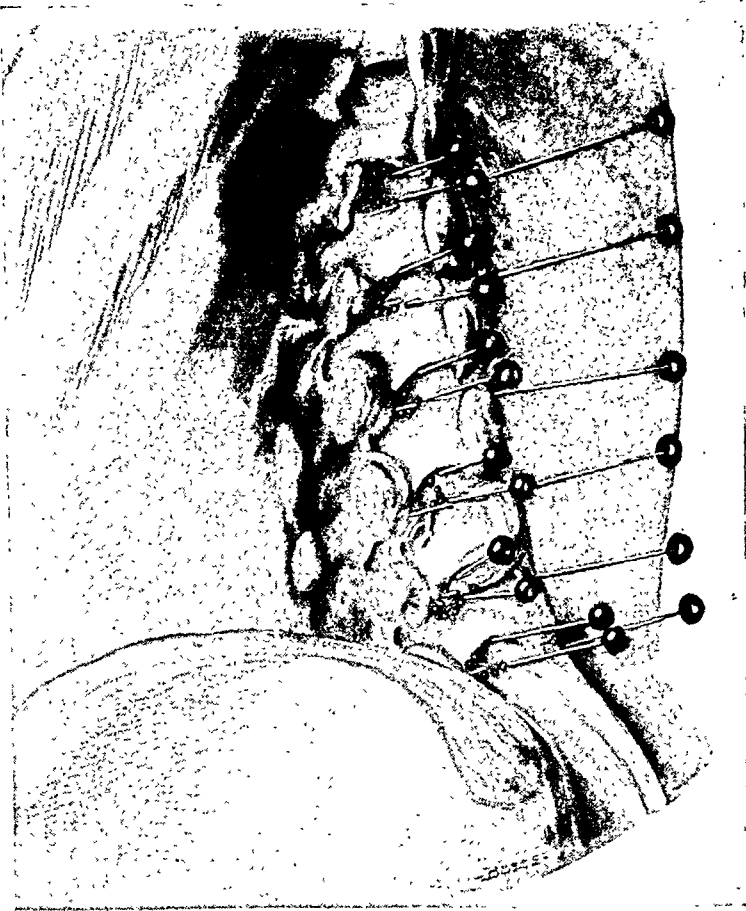


FIG. 14.—Dissection F, Type IV (6.6 per cent.) (cf. Fig. 15). The nerve-roots of the cauda equina were here separate and disposed peripherally within the subarachnoid space, each nerve being attached by delicate adhesions to the arachnoid membrane throughout its course. As soon as the subarachnoid space was laid open, the laterally and posteriorly situated roots were tacked with threads to the dura, in order to maintain their normal relationships to the spinal theca when the latter's flaps were spread widely apart. The sacral nerve-roots were not here made taut by the descent of the sacral lever, though the subarachnoid space reached to the lower border of the third sacral vertebra. This was one of the three out of eleven dissections, in which a subarachnoid space was found behind the cord all the way up into the cervical region.

FIG. 16.—Dissection G, Type V (6.6 per cent.) (cf. Fig. 17). The nerve-roots diverged in flattened ribbon-like bands from a central stalk. The nerve structure of the cauda equina arched transversely backward into the posterior region of the subarachnoid space, so that a greater area of the latter space was situated in front of the nerve-roots than behind them. The artificially made cleft in the central stalk, held open by a stick, demonstrates a considerable open space in front of the nerve structure. The relations of the arachnoid sac will be best understood by reference to the diagram of a cross section of this specimen (Fig. 17). The mesially lying sacral nerve-roots were taut in extreme descent of the sacral lever, but relaxed in the erect position of the body. The subarachnoid space reached down to the lower border of the third sacral vertebra. This was one of the three out of eleven dissections in which a subarachnoid space was found behind the cord all the way up into the cervical region.

FIG. 18.



View of posterior aspect of the lumbar portion of a spinal column, seen at an angle of about  $40^\circ$  with the median sagittal plane. The body was suspended in the almost vertical position. The bony limits of the interarcual spaces are indicated by the pins. *The small black pin heads* outline the extents laterally of these spaces. The third lumbar interspace shows considerable bony encroachment. The lumbosacral interspace is the largest of any, is nearest the skin surface, and its ligamentum subflavum offers less resistance to a needle than do the others. *The shorter large-headed pins planted in a forward direction* were introduced as nearly straight forward as possible at the upper and lower limits of these spaces close to the spinous processes. They therefore indicate the levels of these deep points with relation to the posterior extremities of the spinous processes. *The longer large-headed pins* were passed transversely through the interspinous ligaments close to the upper margins of the spinous processes. Excepting in the fourth lumbar interval, these pins protrude at the levels of the lower of the two large-headed pins directed straight forward in each interspace. In the fourth lumbar interspace the transverse pin lies a little higher. A large exostosis projected downward and to the left from the lower border of the spinous process of the fourth lumbar vertebra. The lower borders of the laminae, projecting prominently backward, are considerably more superficial than are the upper borders, and therefore become, when touched by the needle point, bony guides (see p. 477).

*Site of Greatest Safety for Performing Lumbar Puncture.*  
—The one site at which lumbar puncture of the subarachnoid space could have been made without liability of injuring the nerve-roots in all of the fifteen dissections, using a needle not too sharply pointed (Figs. 15 and 17) and relaxing the mesially lying nerve-roots by sacral extension, was mesially in the interval between the fourth and fifth lumbar vertebræ (see Fig. 13). A puncture mesially in the lumbosacral space could probably have been done with equal safety in all the dissec-

FIG. 17.

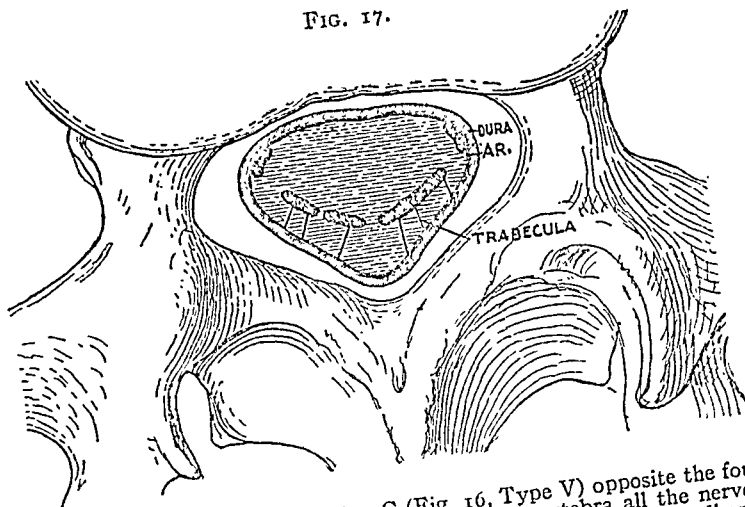


Diagram of cross section of Dissection G (Fig. 16, Type V) opposite the fourth lumbar interspace. Below the lower border of the fifth lumbar vertebræ all the nerve-roots were adherent to the arachnoid. Above this level the arachnoid was firmly adherent over the posterior surfaces of the laterally situated nerve-roots of the cauda equina, while mesially it lay loosely over the posterior surface of the nerve structures, to which it was connected by delicate trabeculæ from about one-eighth to one-quarter inch in length, the shorter trabeculæ occupying the more lateral positions. Fluid tests were not made, but it would seem likely that in the presence of a fluid content within the arachnoid sac, with the nerves relaxed by posture, there would have been mesially in the posterior part of the sac a depth of about one-quarter of an inch of fluid which could be traversed by the puncturing needle before nerve structure would be touched.

tions, but it must be regarded as second in order of desirability, since at this level there was a greater tendency for the nerve-roots to become adherent to the posterior wall of the arachnoid sac, as well as for the subarachnoid space to become shallower. In one dissection the subarachnoid space terminated at the upper border of the first sacral vertebræ.

#### THE TECHNIC OF LUMBAR PUNCTURE.

Quincke<sup>7</sup> early urged the importance of puncture of the spinal subarachnoid space only below the level of the conus

medullaris, and, as well, of making the puncture in the median line, to which latter procedure he made an exception in the case of muscular males, who have particularly tough median line structures, on whom he advised instead a puncture entering at a slightly lateral point and aimed at the posterior median line of the spinal theca. Dönitz,<sup>8</sup> after having produced half-sided anæsthesia in three instances consequent upon the injection of an anæsthetic solution into the lateral portion of the subarachnoid cavity with the patient in the sitting position, insisted upon the necessity of median puncture, so that the needle point should enter a median cleft between the two halves of the cauda equina described by Quincke, and thus avoid the laterally lying nerve-roots. Quincke<sup>9</sup> employed the lateral position for puncture in order that the elastic tension in the arachnoid sac could be measured apart from the influence of the hydrostatic pressure of the column of fluid that would be brought into play by the erect position. He contended that the subarachnoid pressure should not be lowered below the normal. He says (*Deuts. Kl.*, vi) that Krönig found that in adults the lumbar pressure in the horizontal dorsal position was 125 mm. and in the sitting position 410 mm. Hosemann,<sup>10</sup> of Rostock, measures the subarachnoid pressure by Quincke's method, in spinal anæsthesia, reducing it if raised, to 120 mm., or raising it if reduced, which is the condition more often found, by giving saline solution subcutaneously or by rectum. He thus controls the sequel headache. Müller<sup>11</sup> a year later reports a continuation of this practice with satisfaction at the Rostock Klinik.

Michelsson estimates roughly the subarachnoid pressure from the force of the stream through the needle, and withdraws more or less of the cerebrospinal fluid accordingly. Quincke<sup>12</sup> refers to Ossipow's experiments on dogs to demonstrate the effect on the circulation of the central nervous system of the withdrawal of the cerebrospinal fluid. He says: "The rather rapid removal of the fluid resulted not only in a hyperæmia of the cortex and substance of the brain and cord, but also in small hemorrhages, and, where the animals were allowed to live, in degeneration of the ganglion cells of the



cord." H. Tyrrell Gray<sup>13</sup> who, in spinal anæsthesia practises withdrawal of the cerebrospinal fluid until its flow is obviously influenced by the respiratory movements, writes: "The withdrawal of a considerable quantity of cerebrospinal fluid has no discernible constitutional effect on the patient."

The writer is inclined to believe, in theory, that the greater the reduction in the amount of the cerebrospinal fluid in the subarachnoid space, excepting to a point of complete depletion, the greater will be the distance through which the fluid that remains will shift cranialward should the head be lowered. Gray is very careful to keep the head elevated on account of using an anæsthetizing solution of a heavy specific gravity.

Dönitz employed the sitting posture in order that the needle could be driven forward more accurately in the median line. Both Quincke and Dönitz employed the position of extreme lumbar flexion. Sellheim<sup>14</sup> explained that the tension produced by forward bending of the body brought into prominence the median sagittal cleft, between the two halves of the cauda equina. Quincke advised puncture below the second lumbar vertebra to avoid the conus medullaris. Bier<sup>15</sup> punctured between the second and third, or first and second lumbar vertebræ. Colombani<sup>16</sup> preferred the fourth lumbar interspace.

*The Needle.*—Strauss<sup>17</sup> has said that to penetrate the median interspinous ligamentous structures the point of the puncturing needle must be as sharp as possible. He first used Quincke's needle and then Bier's. Sellheim<sup>18</sup> advocated the use of a needle as blunt as possible so as to preserve the sense of touch. He says that the angle of obliquity of the long axis of the opening in the needle point with the shaft should be about  $50^{\circ}$ , and that the margin of the opening should be rounded off. The needle should be provided with an obturator which exactly fits the point.

The writer is of the opinion that a moderately blunt needle, as well as giving greater perception to the sense of touch, is less likely to cause injury to any nerve-roots it may meet or to become obstructed by such roots than is a sharply

pointed one (see Fig. 15, and descriptions in the text of Types IV and V). Bier recommended that the point of the needle should be short to ensure its complete entrance within the subarachnoid space, since a long point, if arrested when but partially passed within the spinal theca, might both tap the subarachnoid space and at the same time be the cause of a peridural spilling of the injected fluid.

Slamjer<sup>19</sup> advises that the needle should have a short oblique point for the same reason. Barker<sup>20</sup> avoided this difficulty by threading through his needle a canula which projected beyond the point. The needles should be made of platinum or pure nickel, neither of which metals rust, the importance of which lies in the fact that the drugs used for spinal anæsthesia are decomposed by an alkali, and therefore the implements with which they come in contact must be boiled in plain water. The diameter generally recommended for the needles is about 1 mm. Slamjer suggests that a needle of too great a diameter may make so large a puncture in the spinal membranes as to allow a reflux of cerebrospinal fluid through it after the needle has been withdrawn. Sellheim describes a manner of holding a relatively blunt needle when puncturing in the median line, in a way to employ the sense of touch, as follows: "The puncturing needle, after penetration of the skin and the superficial ligamentous structures, is strongly grasped by the index finger and thumb of each hand, while the other fingers find as many points of support as possible on the back, on either side of the site of puncture. In this position a deep touch perception can be most delicately observed by the play of the fingers." He could thus determine by the sense of touch when the point of the needle had passed the resistance of the ligamentous structures. He estimated the distance between the ligamentum subflavum and the cerebrospinal fluid in corpulent people to be about 1 cm.

*Hemorrhage.*—Hemorrhage arising from spinal puncture may be either epidural or subdural. If pure blood flows out through the needle, the source of the hemorrhage is epidural. If blood-tinged cerebrospinal fluid is drawn, the source is

subdural (Quincke). Since the posterior epidural venous arcades underlie the bony arches of the lumbar spine (p. 451), and since the mesially lying anterior epidural venous plexuses occupy only the transverse hollows of the posterior surfaces of the lumbar vertebræ (p. 451), there are therefore normally no sizable epidural veins in the line of a straight, forward puncture, which is directed toward an intervertebral disk, and the liability of hemorrhage occurring from this source is very slight. Borschardt<sup>21</sup> reports a case, however, of a 60-year-old man with an enlarged prostate, in which after an injection of 0.06 g. tropacocaine, followed by high pelvic elevation, collapse and death supervened. The autopsy showed an epidural hemorrhage which with the high pelvic elevation had flowed upward to the second or third cervical vertebra, while the sacral canal contained no blood. Borschardt does not attribute the cause of death any more to the hemorrhage than to the tropacocaine and high pelvic elevation. Bolton<sup>22</sup> has questioned whether it would be possible for the cord to be compressed at all by bleeding into the epidural tissue.

Concerning subdural hemorrhage, in König's case of paraplegia (p. 481), the subarachnoid injection of stovaine was made directly upon having drawn through the needle cerebrospinal fluid colored light red, regarding the impropriety of having done which, König, in reporting the case, made the following reflection: "We must regard as an absolute rule the principle already laid down by Dönitz, though for somewhat different motives, to inject the anæsthetic only when clear liquor is drawn." Bier says in this regard: "If blood drops forth and is not soon succeeded by clear liquor, then the needle should be withdrawn and reintroduced in another intervertebral space." Michelsson says: "A fresh puncture seems to us necessary only in those cases where the cerebrospinal fluid is bloody and does not quickly clear up. In the cases where we injected nevertheless, we most always have seen total failures." He regarded that the blood admixture with cerebrospinal fluid neutralized the effect of stovaine.

*Slow Dropping of the Cerebrospinal Fluid from the Punc-*

*turing Needle.*—In seeking for the cause of this manifestation among the anatomical findings of this work, the evidence has been in favor of attributing a slow dropping of the cerebro-spinal fluid through the needle to the impalement of a nerve on the point of the latter (see text Types IV and V, pp. 465 and 466) which would manifestly be more likely to happen with the use of a needle having a sharply pricking point and in the presence of tensed nerve-roots lying in the line of puncture, than with a needle having a relatively blunt point and with the mesially lying nerve-roots of the cauda equina relaxed. Bier says on this subject: "The anæsthetic should never be injected before the liquor flows out in quickly following drops. The neglect of this rule causes most of the so-called 'failures.' The needle should be turned with very slow forward pushing or backward drawing until the liquor flows right."

*The Cardinal Principles.*—The writer would enumerate these as follows:

1. The posture of the patient should be one embodying pelvic extension (elevation of the sacral lever), for the purpose of assuring relaxation of the mesially lying sacral nerve-roots of the cauda equina, that they may the better elude the needle-point.
2. Puncture should be made only in the fourth lumbar (preferably) or the lumbosacral interspace.
3. The point of the needle should be aimed at the posterior median line of the spinal theca (Quincke, Dönitz, Gerstenberg and Hein, Sellheim, and Fig. 13).
4. The point of the needle should be short to ensure its complete entrance within the subarachnoid space (Bier), and relatively blunt both for adding delicacy to the sense of touch (Sellheim), as well as to reduce to a minimum the liability of impalement upon it of the nerve-roots (see text Types IV and V, pp. 465 and 466).

The question would now arise, as to what plan of technic would best inculcate these principles.

*The Posture (sacral elevation).*—In the erect position of the body the pelvis is tilted sufficiently backward to relax

the sacral nerve-roots, and also the amount of space between the spinous processes (Fig. 18), though less than with acute lumbar flexion, is sufficient for the performance of median lumbar puncture. In forced lumbar extension the spinous processes crowd closely together, which movement, when suddenly made by the patient during median lumbar puncture, may cause breaking of the needle.

In the lateral position, pelvic extension can be maintained by straightening the dependent thigh, and then, in order to keep the balance, the leg and thigh of the opposite side can be flexed until the foot of this side rests upon the knee of the dependent extremity.

*The Choice of the Route of Puncture.*—In this connection there arises the question of the necessity for the use of a needle with a relatively blunt point for the purpose of lessening the danger of injury to the nerve-roots, the fact for consideration being that a needle of this description can be passed through the intercepting structures of the lateral route with a delicacy of touch which is impossible by the median route. So that, if the lateral route with the use of a relatively blunt needle can be shown to at least be as safe as the median with the use perhaps of a sharper needle, it would naturally become the route of choice.

Certain of the anatomical facts here demonstrated would seem to throw some light upon this problem. The three dissections E, F, and G (Figs. 13 to 17) were the only ones of this series in which the route of puncture or shape of the needle point could have had any bearing on injury to the nerve-roots. In every one of the other 12 dissections, the anatomy was such that, with sacral lever raised, the subarachnoid space could have been tapped through any one of the three lower interarcual spaces, without danger of injuring any of the nerve-roots by either lateral or median route, and with a sharply pointed needle as well as with a blunted one.

The original operation of median lumbar puncture proposed by Quincke was based upon the proposition that the cauda equina invariably divided at the conus into two lateral

halves, having a cleft between them from 2-5 mm. in breadth, through which interval alone the cerebrospinal fluid must be drawn. Dönitz and Sellheim in their essays on technic reiterated Quincke's argument for median puncture.

Out of the whole series of 15 dissections here presented, Dissection E (Fig. 13) was the only one in which the cerebrospinal fluid would have had to have been drawn from between the two halves of the cauda equina. The cleft in this dissection did not visibly spread on cutting through the arachnoid window attached to its two sides, so that the illustration gives a good idea of the available space there would have been here for puncture. In this dissection an exact median puncture through the fourth lumbar interspace would have been the ideal operation. Yet in seeking to establish one technic to best meet all anatomical variations, provided in all other complicating arrangements of the nerve-roots (Dissections F and G) it can be shown to be desirable to employ a relatively blunt needle and a lateral route of puncture, it would seem to be the question for consideration in the case of Dissection E, whether for it too the blunted needle and lateral route might not be utilized at least as a very good compromise in place of median puncture if not as an equally good procedure. (See *mesial puncture of the spinal theca by a lateral route*, p. 475.)

The other two dissections, F (Figs. 14 and 15) and G (Figs. 16 and 17), for special consideration, are the ones which argue strongly for the use of the relatively blunt needle, though for different reasons, Dissection F in order that the needle may be one that can drive a wedge of dura between the nerve-roots before it penetrates, and Dissection G in order that the needle may be one that the posteriorly lying nerve bands, relaxed by elevation of the sacral lever, can best elude. In neither of these dissections does the importance of a direct forward median puncture for entrance into the subarachnoid space seem to be demonstrated, and on the other hand there would seem to be every reason for using as blunt a needle as possible, introduced with the utmost delicacy of

touch, which conditions are best fulfilled by the lateral route.

*Anatomy of Median Lumbar Puncture.*—A tubercle projects downward from the lower margin of a lumbar spinous process close to its posterior extremity, so that in performing median puncture the needle should be made to follow as closely as possible the upper border of the lower spinous process of the interspace through which it is passed, to avoid encountering the tubercle.

In median lumbar puncture the needle is liable to some little deflection from the exact median plane. The writer planted two hat pins straight forward in the spinal canal, one introduced in the interspinous interval in a line which was thought to occupy the exact median plane, and the other, one-third inch lateral to the first. On dissecting out the points, they were found to have entered the spinal theca close together a little lateral to the middle line. Gerstenberg and Hein say that a little deviation of the needle from the median line makes no difference.

The supraspinous ligament measures about one-quarter inch across, while the interspinous ligament at its middle portion is only about one-twelfth inch thick. Quincke estimated the depth of lumbar puncture to be usually from 4 to 6 cm.; in large muscular men from 7 to 8 cm.; and in fat people even to 10 cm.

The depth of puncture in the lumbosacral interspace is perceptibly shallower than is that in the lumbar interspaces above.

*Mesial Puncture of the Lumbar Spinal Theca by a Lateral Route.*—H. Tyrrell Gray<sup>23</sup> practises lateral puncture exclusively. He says: "These dangers" (those of lateral puncture) "I am convinced have been greatly exaggerated." He states that in some hundreds of lumbar punctures the nerves had been touched by the needle or canula on only three occasions. Gray, from a point just lateral to his finger-tip placed on the interspinous interval in the median line of the back, directs the needle very slightly upward and inward. "The needle can be felt in its course to penetrate two re-

sistances: (1) the ligamentum subflavum, and (2) the dura mater." The writer has employed the same deep guides for a number of years in a limited experience with lateral lumbar puncture, using a needle without a sharply pricking point, since in this way he had found that he could be guided by the sense of touch. Slamjer, in reporting 2700 cases of lumbar anæsthesia with tropacocaine, says: "The puncture was either lateral or median without our having seen any remarkable difference resulting."

The ligamentum subflavum in the lumbosacral interspace is thinner than are those in the lumbar spaces above, and consequently offers a considerably less resistance to the penetrating needle.

*In fat people*, in whom the spinous processes cannot be differentiated by palpation through the skin, *the lumbar interspinous interval can be located* in two ways, one by prodding with a needle from a slightly lateral position across the median line structures, and the other by touching with the needle the lower border of a lamina near where it joins the spinous process. The latter site is recognized by its superficial location, three-fourths to one inch beneath the skin surface, the conformation of a lumbar lamina exhibiting a rather prominent backward slope from above downward, so that its lower border overhangs considerably the upper margin of the lamina immediately below it (Fig. 18). Consequently if the puncturing needle, introduced close to the median line structures, strikes bone thus superficially, the point of contact must be offered by this prominent lower border of the lamina, which indicates that the course of the needle is just a little above the level of an interarcual space.

In order to as accurately as possible penetrate the posterior median line of the spinal theca with a needle introduced through a lateral route, the point of the needle must first be made to touch some deep guide from which, as a point of ultimate departure, it can take a short and direct course to its final destination. With the attempt to direct the needle from a point of slightly lateral entrance on the skin surface



in one straight line to the posterior mesial area of the spinal theca, the needle point may very easily get outside of the limits of the interarcual space. Thus it was found by this method that the point could pierce the interspinous ligament and impinge on the lamina of the opposite side, or that it could strike the under margin of the spinous process. The deep guide in the procedure here proposed is the ligamentum subflavum or the bone adjacent to it, which is met by the needle when passed straight forward through the erector spinæ muscle, parallel with and closely adjacent to the interspinous ligament. The close relationship of the course of the needle to the latter structure is advisable, in order that the needle can be made to enter the posterior mesial area of the theca with as little inclination from the median sagittal plane as possible. The point of entrance selected was therefore one quarter inch from the median line of the back, and the needle, taking thence a straight forward course, should consequently reach the level of the interarcual space also one quarter inch from the median sagittal plane. A short longitudinal stab wound of the skin should be made at the site of entrance of the needle. This incision is necessary for the entrance of a relatively blunt needle, while at the same time it does away with the binding influence of the skin on the shaft of the needle, as well as avoids the danger of contamination of the needle by the bacteria of the skin.

The resistance of the interarcual area is encountered at a depth of from one and one-half to two inches beneath the skin, excepting opposite the lumbosacral interspace where the depth is less. After the needle has encountered the resistance of the spinal column (usually that of the ligamentum subflavum), it should not be attempted to push the instrument straight through into the subarachnoid space, but instead, before trying to complete its introduction, it should first be slightly withdrawn until its point lies free in the muscle, and then from this latter position it should be given its direction toward the posterior median line of the spinal theca, which is done by inclining it at an angle of about 5 degrees

with the median sagittal plane. The needle will then usually pass unobstructedly through the firm structure of the ligamentum subflavum to penetrate the spinal theca. Sometimes, however, the angle must be increased to about 7 degrees to get over a lateral bony obstruction. Or, if this slightly increased slant of the needle be of no avail to elude the bony opposition, then the latter is probably due to a high projection of the upper margin of the spinous process, to get above which, the point of the needle should be gradually worked upward, maintaining all the time the inward inclination of 5 degrees, until finally the point finds entrance beneath the middle of the upper bony arch of the space. An upward slant of the needle of from 5 to 10 degrees may be necessary.

Certain advantages of the lateral route over the median can be summarized as follows:

1. The needle can be guided more by the sense of touch.
2. There can be used a needle with a less sharp point, which both aids the sense of touch and is less liable to cause nerve injury.
3. With a correct technic, the posterior mesial area of the spinal theca can be entered in almost as straight forward a direction as is possible by the median route, and apparently about as near the median line.
4. There is no danger of breaking the needle.
5. The operation is capable of performance, if desired, in the position of extreme lumbar extension.

#### PARALYTIC SEQUELS OF LUMBAR PUNCTURE AND THE LUMBAR INJECTION OF A SPINAL ANÆSTHETIC.

But one reference to a paralytic sequel following lumbar puncture *per se*, was found in literature. Slamjer,<sup>24</sup> speaking of permanent nerve paralyses following spinal anæsthesia, says: "Quincke saw such a paralysis occur as a result of simple lumbar puncture, the reason for which he attributed to a hemorrhage in the nerve substance." There were found, however, a number of reported cases having paralytic sequels following the lumbar injection of a spinal anæsthetic, a brief

consideration of which it was thought might be illuminating to the subject matter of this paper.

These paralyses following the lumbar injection of a spinal anæsthetic became apparent either closely consecutive to the recovery of the patient from the effects of the anæsthesia, or else later after an interval of complete restoration of function to the patient. They are regarded to be due either to trauma inflicted on the nerve structures by the puncturing needle, or to some irritative action of the solution injected. It can be seen that paralyses attributable to the former cause must be limited to the lower half of the body, and that their onset, as in the case of any severe nerve injury, ought to be immediate. The late occurrence of a paralysis would seem to be at total variance with a traumatic origin, and might consequently be regarded as characteristic of an irritation by the anæsthetizing drug. In support of the latter proposition is the fact that paralyses of the upper extremity and more frequently of the eye muscles, following the lumbar injection of a spinal anæsthetic, which could by no possible logic be attributable to the traumatism of a lumbar needle puncture, are characterized by a late onset. These late occurring paralyses are sometimes permanent.

Owing to an almost general obedience to Quincke's early injunction to enter the puncturing needle below the *conus medullaris*, which could then only encounter individual nerve-roots, the cases of paraplegia following lumbar anæsthesia attributable to the needle puncture have been few. On the other hand isolated paralyses of the lower half of the body following lumbar anæsthesia, which might be due to injury of individual nerve-roots of the *cauda equina*, are more frequent. The latter sequels seem to affect exclusively the bladder and anus and the area of distribution of the peroneal nerve. That the nerve-roots of supply to the bladder and anus, which are the third and fourth sacral, should be ones of selection for injury by the needle it is easy to understand, since they occupy the most mesial position of all the nerve-roots of the *cauda equina*, and consequently, excepting where a mesial cleft exists, lie in line with a median puncture.

As regards the liability of causing injury to an agglutinated mass of nerve-roots by puncturing them with a needle, Dönitz's<sup>25</sup> three cases of half-sided anæsthesia, and that of Trautenroth,<sup>26</sup> resulting from the injection of the anæsthetic solution laterally within the spinal theca, are instructive. Dönitz employed the sitting position, so that any possible influence of gravity to retain the injected fluid all on one side could be eliminated. No ill results were recorded. Trautenroth, with the patient in the left lateral position, produced a right-sided anæsthesia, so gravity in his case too could have played no part. He introduced the needle to the left of the median line and aimed it obliquely toward the median line. The patient experienced a severe pain in the right leg, whereupon the operator, without withdrawing liquor, injected 0.06 g. tropacocaine with resulting anæsthesia of the right lower extremity only. The other side of the subarachnoid space was then injected with 0.045 tropacocaine. Headache was the only sequel. Oelsner and Kroner<sup>27</sup> have published a case, in which, during the operation for spinal anæsthesia, there was pain in the right leg as if a nerve of the cauda equina had been struck. The pain disappeared after one to two minutes. There was no change in the pulse or respiration, and there were no serious complications or sequels.

The comparative infrequency with which paralysis has followed lumbar puncture, in the face of the indisputable anatomical evidence here presented that nerve-roots may so frequently be in relation with the posterior arachnoid wall opposite the second and third lumbar interspaces, would seem to be in evidence that the trauma of a needle penetrating nerve-roots of the cauda equina is generally well borne. This observation, however, should not be construed as furnishing a reason why the utmost punctiliousness should not be observed to avoid the nerve-roots in practising lumbar puncture.

#### *I. Whole Lower Extremity Paralysis Immediately Following Spinal Anæsthesia.*

I. TRAUTENROTH: *Ein Fall von schwerer Stovainvergiftung nach Lumbalanæsthesie nebst Bemerkungen über halbseitige Anæsthesien*, Deuts. med. Wochenschrift, 1906, p. 7. *Forceps extraction.*

Patient on left side. Point of entrance of needle between the first and second lumbar vertebræ about 1 cm. to left of median line. No cerebrospinal fluid came through the needle, but nevertheless half a Pravaz syringe of 1:1000 adrenalin solution was injected. With a new puncture between the second and third lumbar vertebræ, cerebrospinal fluid was drawn; 1 in 1000 adrenalin solution was now injected, followed in three minutes by 0.06 g. stovaine. Ten minutes after the injection the woman was in bad condition. Pulse small and slow. Breathing slow and superficial. Cyanosed. The anæsthesia reached to the neck. Fifty minutes after the birth, sensation had returned to the navel, and the lips were red. The left leg could not be moved by the patient for seven hours and the right leg until several hours later. On the following day the patient could not properly lift the right leg. Sudden severe headache on the night of the fourth day with general pains over the body. The right leg was as though asleep. Ninth day right leg seemed to the patient icy cold, as though dead. No temperature difference between the right and left legs. Not until five weeks after the puncture did the patient first leave her bed, in which she had remained on account of pains in the back and lameness in the right leg. She could walk only with trouble. The temperature had been normal.

2. KÖNIG: *Bleibende Rückenmarkslähmung nach Lumbalanæ.*, *Münch. med. Wochenschrift*, No. 23, 1906, liii, 1112.

Needle introduced between the third and fourth lumbar vertebræ, whereupon the patient experienced pain. As soon as the liquor, which was colored light red, came from the needle in drops, stovaine-Riedel (0.06 stovaine) was injected. Anæsthesia of lower abdomen. "The lost function about from the navel downward, including bladder, rectum, and extremities did not return." On the fifteenth day a lumbar puncture was made, drawing a light red sterile fluid containing isolated red cells and mononuclear leucocytes. Patient died after three months with cystitis, etc. Autopsy: The spinal cord from about the level of the ninth vertebra downward was adherent to the dura. In the lumbar portion a space remained in which there was found no abnormal fluid. In the lower dorsal and in the lumbar regions the cord on section presented the picture of softening.

3. BOSSE (Hildebrandt): *Berl. klin. Wochenschrift*, 1906, xliii, 369. *Disk. zu Lazarus*.

Age 59. Examination of prostate. Stovaine. At the conclusion of lumbar anæsthesia, without other toxic sequels, the paraplegia continued. The paralysis on one side lasted until the fourth day, while the paralysis on the other side remained until death, four weeks later, of an ascending nephropylitis.

4. GOLDSCHWEND: *Ueber 1000 Lumbalanæ. mit Tropakokain*, *Weiner kl. Wochenschrift*, 1907, xx, 1098.

"In high grade disquieting were the rare cases of long lasting paraplegia (3 in 1000). In the most severe case it lasted eight days, after which the motility gradually returned. . . . The paraplegia affected only the lower extremities and not the bladder."

## II. Whole Lower Extremity Paralysis Following a Complete Recovery of Function After Spinal Anæsthesia.

WALTHER: *Bull. et Mem. de la Soc. de Chir. de Paris*, 1905, *xxxi*, p. 214. *Meningo-myelitis consec. a la rachicocainisat.*

Male, age 20. Case admitted to hospital with the following history: February 25, 1903, subarachnoid injection of cocaine. No sequels. May 27, 1903, subarachnoid injection of cocaine without loss of sensibility. Nothing abnormal until third day, when motion and sensation of the lower extremities began to fail and progressed until at the end of ten days they had entirely disappeared. Third week incontinence of urine and fæces. After four or five months control of anus and bladder had returned to normal. After eight months the movements of the lower extremities began to return a little. After 21 months he still could not walk. Lower extremities showed some contracture, increased tendon reflexes, and spasticity. Sensation to heat, touch, and pain was present. The case was diagnosed as one of meningomyelitis.

DANDOIS: *Journ. de chir. et Annal de la Soc. Belge de Chir.*, 1901-4, p. 282.

External urethrotomy. Age 57. 0.02 cocaine. On eighth day pains in pelvis and lower extremity. Ninth day complete paraplegia. Sensation preserved. Delirium. No fever. Twenty-fifth day slight movements in lower extremities, followed by complete recovery.

## III. Localized Paralysis of the Lower Half of the Body.

HENKING: *Münch. med. Wochenschrift*, 1906, p. 2428. *Erfahrungen über Lumbalanæsthesia mit novocaine.*

Age 28. Hernia. Novocaine. Perfect anæsthesia. After 12 hours patient became restless. Incontinence of fæces and urine lasting 60 hours.

BORSZEKY: *Beitrag z. kl. Chir.*, *lviii*, 1908, 651.

Borszeky refers to a case of bladder paralysis following spinal anæsthesia reported by Wiener, of a "35-year-old perfectly sound man who suffered a total incontinence. The condition of the patient improved after sixteen months only in so far that he could hold his urine two to three hours by day, but not at night. Furthermore erection was incomplete and libido was entirely absent."

STRAUSS: *Deutsche Zeitschrift f. Chir.*, *lxxxix*, 1907, 275.

Strauss reports that after performing lumbar anæsthesia with stovaine on about 300 cases without serious accident, there occurred on the same day two cases of paralysis of both bladder and rectum following lumbar anæsthesia with stovaine. The paralysis of the sphincter ani lasted 10 days. The bladder paralysis lasted in one case 1½ months, and in the other after 3 months a slight paresis still existed.

MICHELSSON: *Arch. f. kl. Chir.*, *xcii*, 1910, 657.

In 400 cases of lumbar anæsthesia there followed disturbances of motion in four cases. Two had paresis of the extremities. Another had a paralyzed sphincter for four days following operation, and the other for six days following operation could not empty his bladder.

BONDY: *Gyn. Rundschau*, *iv*, 1910, p. 99.

Of peripheral paralysis occurring in 1000 cases of lumbar anæsthesia,

there were nine of the peroneal nerve, and trophoneurotic disturbance 10 times.

SELLHEIM: *Medizinische Klinik*, 1910, vi, p. 5.

In 1000 operations under spinal anæsthesia, there were nine cases of peroneal nerve paralysis, all of which disappeared completely.

KÖNIG: *Hohlmeier u. König. Sammelforschung über die Lumbalanæsthesie im Jahre 1909. Verhandl. d. Deutsche Ges. f. Chir.*, xxix, 1910, p. 481.

König collected from the *Centralblatt für Chirurgie* in the years 1908-09, eight reported cases of paralysis of the leg following lumbar anæsthesia, usually limited to the peroneal nerve region, some of which were permanent.

#### IV. Unclassified Cases.

BAINBRIDGE: *Analgesia in children by spinal injection, with a report of a new method of sterilization, etc. Medical Record*, 1900, lviii, p. 937.

Age 7. Slight lumbar kyphosis. Puncture to right of median line between twelfth dorsal and first lumbar vertebræ. Cocaine 9 mms. of a 1 per cent. solution. In nine minutes analgesia up to lower jaw. On third day, patient seemed stupid and did not move right arm and hand, and the legs were drawn up. Eighth day the legs could be extended and patient moved the right arm. Thirtieth day, "he is in excellent condition, better than before operation."

FÜSTER: *Bruns Beiträge z. kl. Chir.*, 46, p. 1. *Erfahrungen über spinal analgesie.*

Age 34. Appendicitis. Injection between second and third lumbar vertebræ. No anæsthesia and ethyl chloride given. Symptoms of spinal meningitis developed with opisthotonus. Eighth day lumbar puncture drew few drops of sanguinolent fluid which was sterile. Tenth day sudden improvement. Eighteenth day cured.

ALLEN: *Spinal anæsthesia. Boston Med. and Surg. Journ.*, clxiii, 1910, p. 715-718.

Age 55. Double inguinal hernia. 1.5 c.c. stovaine Billon injected through second lumbar interspace. Rather marked Trendelenburg position for three minutes then laid flat. Soon after the beginning of the operation the patient lost consciousness and the respirations became Cheyne-Stokes in character. Had complete left hemiplegia which cleared up in less than twenty-four hours, excepting a slight paralysis of the left wrist which persisted two days longer. During the next twenty-four hours there developed a complete paralysis of right leg. This persisted for two weeks. It then gradually cleared up, and in two months was entirely well.

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# THE TECHNIC OF END-TO-END ARTERIAL ANASTOMOSIS.\*

WITH REPORT OF A CASE.

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VASCULAR anastomosis has developed chiefly within our own day. Its history begins, however, with the first arterial suture on June 15, 1759, when Hallowell, at the suggestion of Lambert, closed a wound of the brachial artery by passing a small steel pin, rather more than a quarter of an inch in length, through the two lips of the wound and then twisting a thread around it, as in the hare-lip operation. The closure was successful, and the pulse remained thereafter nearly as strong as in the other wrist. Asman, after fourteen years (1773), on the basis of four unsuccessful experiments on dogs, concluded that a vessel could not be sutured by this method with preservation of its lumen. Wattmann seventy years later (1843), reported that he had performed lateral ligation of a vein with success by holding up the edges of the wound with forceps and surrounding it with a ligature. Nicaise in 1872 maintained that lateral suture was practicable, and stated that Ollier and Gensoul had both performed it. Hirsch (1881) and Braun (1882) did important work on lateral suture, while Gluck (1882) devised a small ivory clamp for closing arterial wounds. Jassinowsky, in 1889, reviewed the general literature of the subject of lateral suture, published an extensive series of personal experiments, and established the procedure on a sound basis.

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Eck, investigating the physiology of the liver, performed in 1877 successful lateral anastomoses between the vena cava and the portal vein of dogs. His technic resembled that of lateral intestinal anastomosis, except that the anastomotic openings were not made until all the stitches had been placed. He used for this purpose a pair of fine scissors, to each tip of which was soldered a length of silver wire terminating in a curved needle. After the posterior line of sutures had been made, these needles were passed through the vessels (one the vena cava and the other the portal vein) at points determining the length of the incision. The anterior line of sutures was then placed, the scissor-blades were pulled into the vessels by means of the wires, and the veins cut between the two lines of sutures. This technic was improved by Stolnikow (1882), Hahn, Massen, Nenchi, and Pawlow (1893), and others, and the subject of Eck fistula forms an important chapter in blood-vessel surgery.

Von Horoch in 1888 tried to sew together the ends of an artery which had been cut across; he was unable to accomplish this without interfering with its patency. Robert Abbe, 1894, of New York, was the first to successfully perform end-to-end anastomosis; he divided the abdominal aorta of a cat and "tied each end over a glass bobbin by a fine silk thread, and tied the ends together." Queirolo and Masini, working on the Eck fistula, introduced in 1895 an appliance consisting of a tube of glass through which one cut end of the artery was threaded and cuffed back and then invaginated into the other end and held in place by a ligature. Nitze in 1897, demonstrated a similar anastomotic aid made of ivory, and Von Karlrew working also on the Eck fistula, improved the technic of its use in 1899. Payr in 1900, apparently without knowledge of the above methods, described in detail two appliances made of an absorbable material (magnesium); for a short time Payr's prostheses were quite popular, and from one form, similar to that of Queirolo, the Crile cannula has developed.

While these men were perfecting anastomotic aids Murphy,

of Chicago, was attempting to develop a technic of suture without aids, and in 1897 he described a successful method of anastomosis by invagination. When dealing with moderately sized vessels, this method proved to be superior to that of Payr. Several men made attempts to improve the technic, especially Bouglé in 1901. Coincidentally with Murphy, Jaboulay and Briau developed a method of end-to-end anastomosis by means of interrupted mattress sutures with evagination of the intima, and in 1898 they presented a specimen to the Medical Society of Lyons, in which there was a perfect union of the endothelium without any thrombus formation. Salomoni in 1900 independently devised a technic similar to that of Jaboulay and Briau. The method of Jaboulay and Briau was improved by the former's pupil, Carrel, into the method which is now generally used.

It was in 1902 that Carrel first described his now famous method of circular suture, converting the circumference of the vessel into a triangle by means of three stay sutures; he also pointed out the necessity of the use of the finest needles and silk and the maintenance of absolute asepsis. Carrel's method has become the method of choice wherever permanent union is desired and has been extensively used by both experimenters and clinicians; among others, Hubbard, Jensen, Floresco, Watts, Stich, Makkas, Dowman and Lund have used it and reported excellent results.

About two years ago we undertook to perform the operation on the abdominal aorta of cats, with the purpose of acquiring facility in the technic. Of our first series of fifteen animals no statistics were kept. Ether was administered with a cone, and the mortality from ether and from bronchopneumonia following operation was high; thrombosis was frequent.

On the basis of this preliminary experience, we perfected the technic of operation after the manner in which we shall describe it, and as we have used it since. We then undertook a second series of thirty cats, which we operated upon between the dates of January 23, and July 29, 1910. The animals were

anæsthetized by the intratracheal insufflation method. The mortality statistics are as follows:

- 2 died of thrombosis within 24 hours.
- 1 died of secondary hemorrhage on 5th day.
- 1 died of complete rupture on 8th day.
- 1 died of false aneurism on 33d day.

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5 operative deaths.

- 1 died of general peritonitis on 6th day.
- 1 died of general peritonitis on 8th day.
- 1 died of general peritonitis on 23d day.
- 1 died of gastro-intestinal on 28th day.
- 1 died of gastro-intestinal on 31st day.

---

5 deaths from infection and intercurrent disease.

The segments of sutured aorta were saved in the five cases that died of intercurrent disease, preserved in alcohol, and photographed (see Fig. 1). It is worthy of note that in this series there were no ether deaths and no cases of post-operative bronchopneumonia.<sup>1</sup>

The deaths from infection and intercurrent disease were the result of the operating conditions and the housing of the cats.

Of the other twenty animals, twelve were killed August 15, 1910, at the request of Prof. E. H. Nichols of the Department of Surgical Pathology, to supply material for the demonstration of the healing of arteries. Four of the remain-

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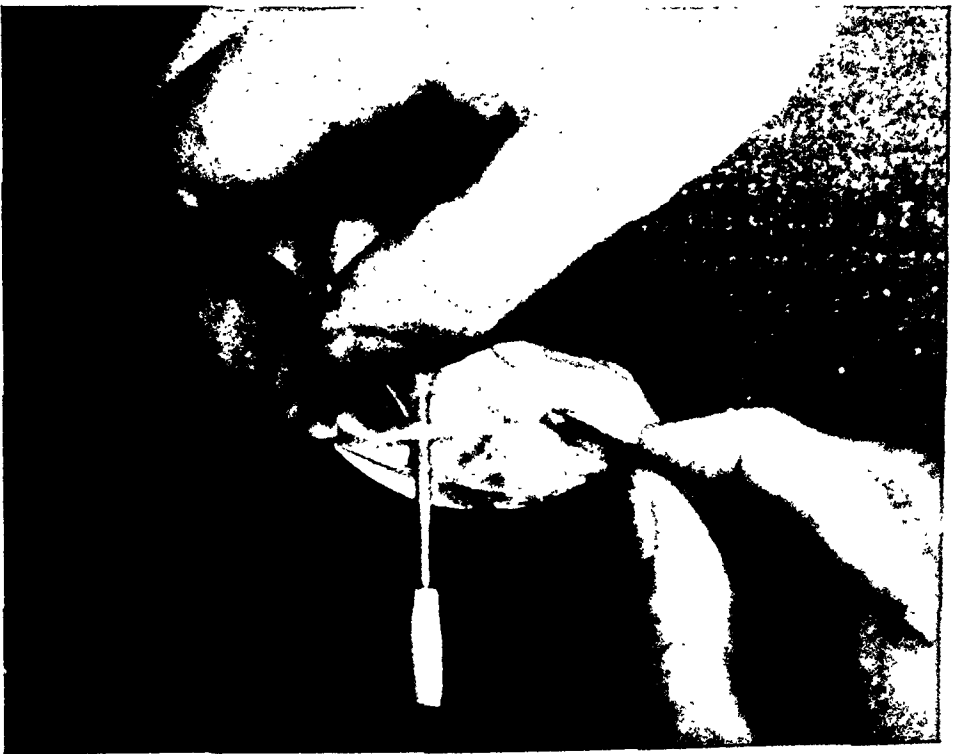
<sup>1</sup> The apparatus which we used consists of a Wolffe bottle half full of ether; through one stopper passes a glass tube which dips below the surface of the ether and is connected by rubber tubing with the air-pressure tap of the laboratory, and the other connects with a straight metal intratracheal tube. Another piece of tubing is connected with the tubing to and from the bottle so as to pass the air current around it, without taking up any ether vapor. This is long enough to lie in a loop upon the floor. When ether is required, from time to time, the assistant presses upon this loop for a second or two with his foot, forcing the air to bubble through the ether. A mercury bottle is connected on to serve as a safety valve, as described by Ehrenfried: *Intrathoracic Insufflation Anæsthesia, Apparatus and Cases*, Boston Medical and Surgical Journal, 1911, clxiv, p. 532.

FIG. 1.



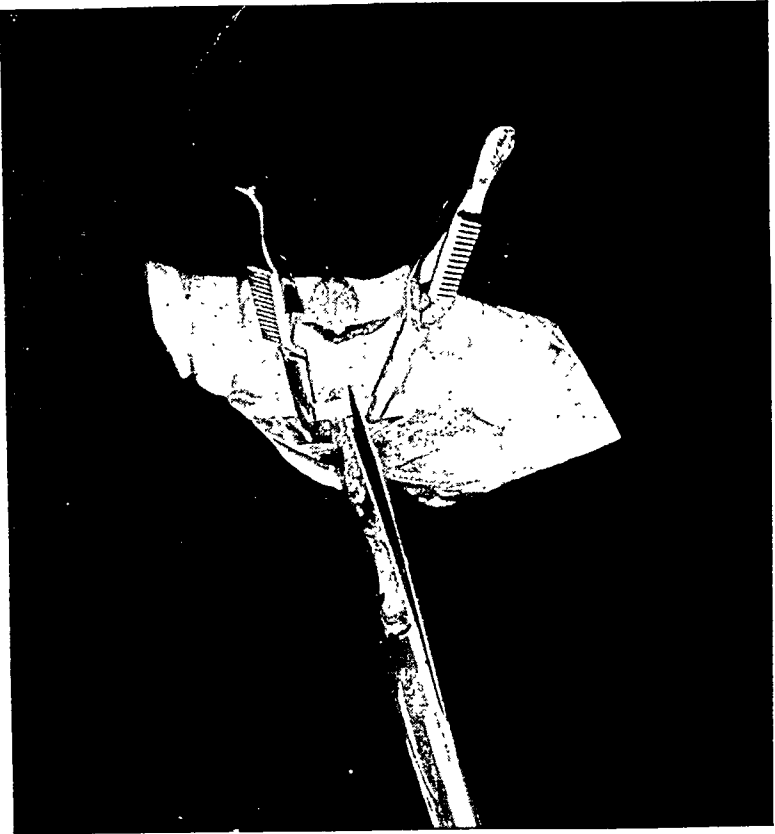
Section of healed aortæ taken from cats which died of intercurrent disease (considerably enlarged).

FIG. 2.



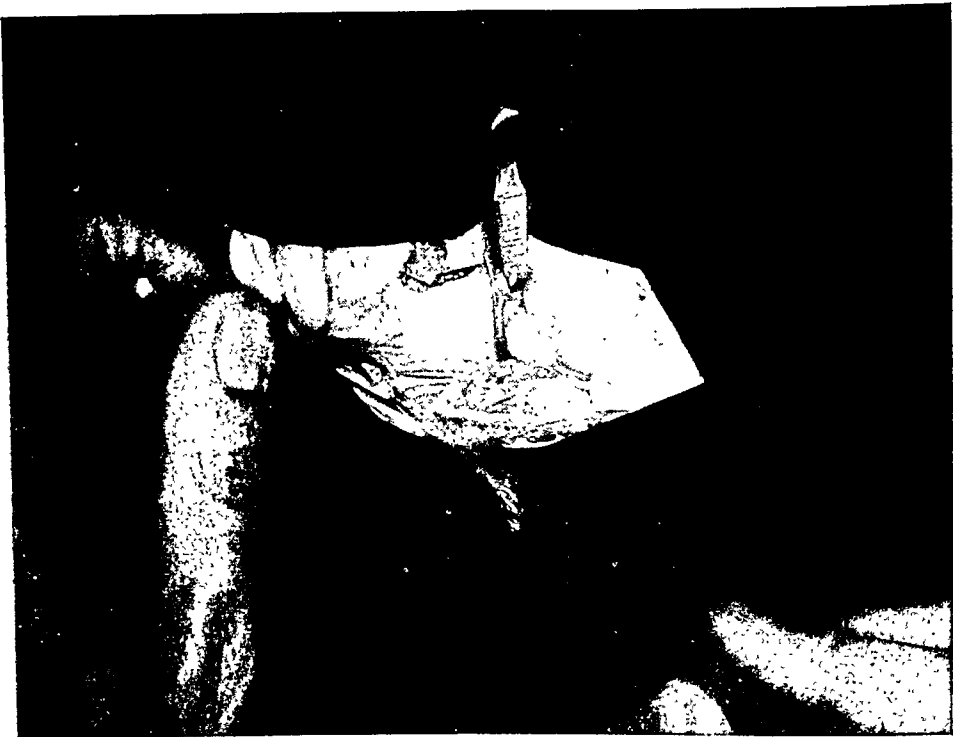
End-to-end anastomosis of divided abdominal aorta in a cat; the retroperitoneal aorta has been opened up, the artery exposed and lifted up on the blunt end of a rod.

FIG. 3.



The clamps have been applied, and the artery is being divided.

FIG. 4.



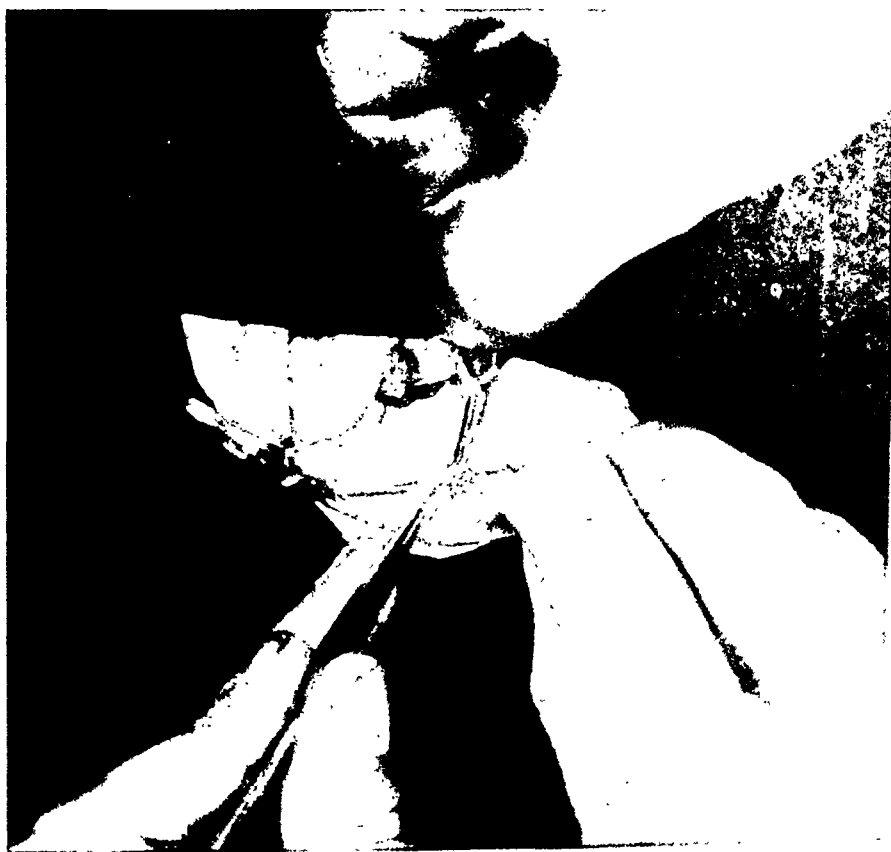
The segments are being washed free of blood and clot with sterile salt solution.

FIG. 5.

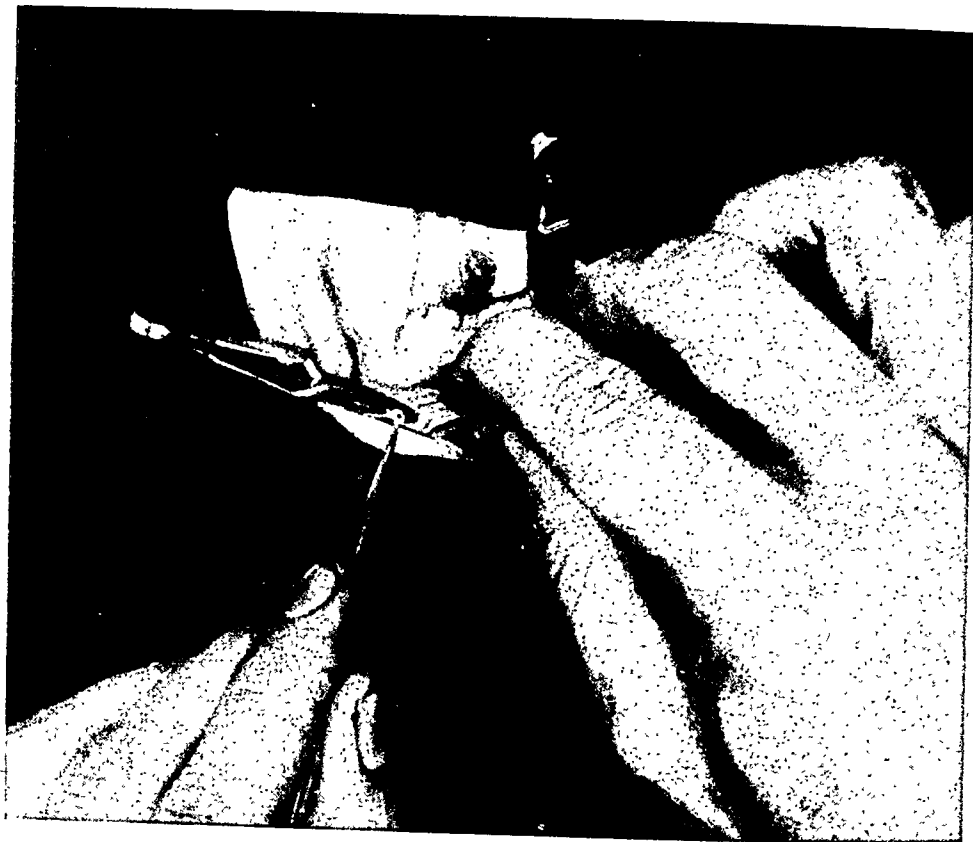


Trimming off the adventitia.

FIG. 6.

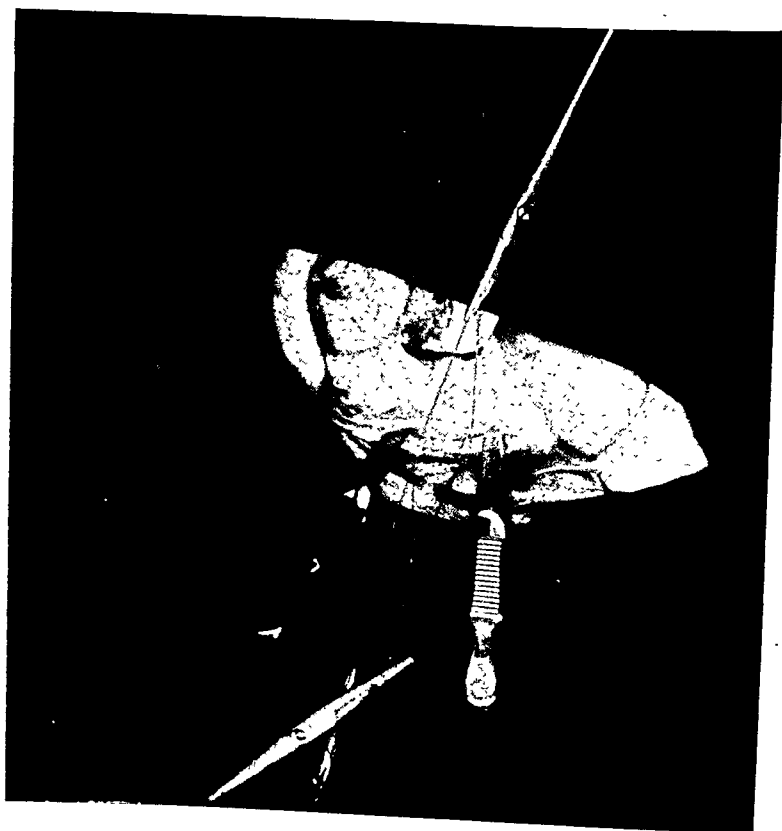


Starting the first stay suture.



Completing the first stay suture.

FIG. 8.



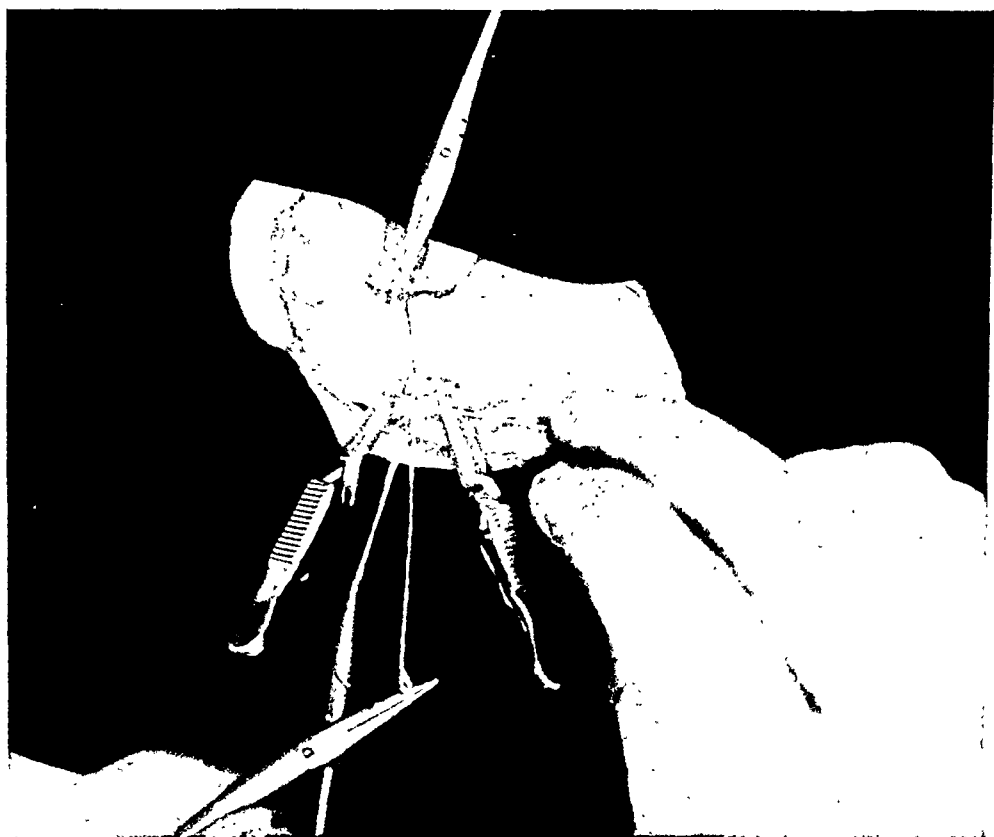
All the stay sutures in place.





The stay sutures have been drawn up and tied.

FIG. 10.



Starting the continuous circular stitch. (The needle and silk used for this series of photographs are coarser than those regularly employed.)



ing cats have died since that date, two have been used for other purposes, and two are now living (Aug. 1, 1911).

The kit which we use in operating contains the following instruments:

Six light mosquito hæmostats for use in tying off collaterals, to snap on the ends of the three stay sutures, and on the end of the running suture after it is tied, in starting. Heavy snaps will tear the vessel wall by their weight.

Two vessel clamps. At Carrel's suggestion we use the small old-fashioned "serrefine," with the blades filed smooth, and the tension of the springs weakened until the blades come together flat with the least possible pressure. On large vessels in the human, Crile clamps may become necessary, but the serrefine is preferable because it is lighter and more easily handled. It is a wise precaution in human surgery to apply a Crile clamp some distance proximal to the cut, to provide against the possibility of slipping of the serrefine.

One blunt dissector, to assist in freeing up a sufficient length of vessel for operative purposes. We make use of a straight blunt aneurism needle.

One fine blunt scissors, curved on the side, to trim off adventitia.

Two pair of smooth jeweler's forceps (Boley, MM, filed blunt). These we have found to be the best adapted of any forceps for handling the fine needle.

One medicine dropper and sterile saline solution, for flushing out the segments of artery before sewing.

One bottle of vaseline, in which to sterilize the silk sutures.

Fine Pagenstecher, for tying off small branches cut in freeing the artery. Catgut swells up and interferes with the operation.

Needles, No. 6 Kirby sharps.

Suture material, No. 0000 Chinese silk, untwisted into the three strands of which it is composed. About 18 inches is threaded on the needle, the needle is stuck through a square of card, and the silk is wound about this. Two such cards are enough for an operation; one length will make the three stay sutures, and another will suffice for the continuous suture. On account of the difficulty of threading, it is wise to economize in the suture material. If the needles are allowed to remain for long in the vaseline, they are likely to become brittle.

The ability to perform end-to-end arterial anastomosis comes only as the result of practice, gained upon the living animal. The best subject of experimentation is the cat; it is inexpensive and not hard to care for. The abdominal aorta is easy to get at; it is approximately the size that would be met with in human surgery, slightly larger than the brachial

and slightly smaller than the femoral artery. If the artery thromboses, or if the lumen is sewed up (the commonest mishaps in the beginner), the cat dies.

The animal selected is given no food the night before. For operation it is strapped upon the board, etherized, and the hair clipped from its belly which is washed with soap and water and rinsed with alcohol. Operative asepsis in all its details is essential; gloves, however, are not worn. The operator stands upon the cat's right. An incision is made from one inch below the ensiform to one inch above pubes. A snap is applied to peritoneum and fascia on either side and thrown back. The intestines are taken out and wrapped in a hot towel on the cat's left. (A black silk laparotomy sheet, with one side long for covering the intestines, is a distinct advantage; against it the needle and silk can be readily seen.) The laparotomy sheet is pinned to the edges of the wound by Bachaus towel clamps to prevent exposure of the skin, and to avoid getting hairs into the operative field.

The retroperitoneal space is opened up by blunt dissection, and the aorta is freed for a distance of about three-quarters of an inch between the superior and inferior mesenteric arteries. Occasionally one or two posterior-lateral branches will have to be tied off; double snap with mosquitoes and tie short with very fine Pagenstecher or silk. Tie off as few branches as possible, because the ties get in the way, and because if the branches which supply the cord are cut the cat dies within twenty-four hours with paralysis of the hind legs. Lift up the vessel on the blunt dissector, apply the clamps, perpendicularly, about one-half inch apart, and cut between. Gently wash out the segments of vessel with salt solution in the medicine dropper, and then apply a little warm vaseline to the cut edges with the blunt dissector. Trim off any redundant adventitia or any connective tissue that might get in the way when suturing.

The three stay sutures are now placed at points equidistant about the circumference of the artery, one stitch being exactly posterior, corresponding to the tips of the clamps. The needle

is passed directly through the vessel wall of the proximal segment, including the intima, and is passed back (from within outward) through the distal segment at the corresponding point. If there is any difficulty, the vessel wall may be grasped by the forceps, which have been dipped in vaseline. The stay is not tied, but its ends are left long, and grasped by a mosquito snap. When the last one has been placed, they are all gently drawn up so as to approximate the cut edges of the artery. While the assistant holds two taut, the operator ties the third, snugly, using a surgeon's knot to prevent slipping. The other two are tied in turn; the tied ends of all are left long and snapped with mosquitoes. The ends of the posterior stay should come out on the cat's left.

Everything is now ready for the application of the continuous suture. The clamp handles are directed to the operator, and the first stitch is applied just anterior to the posterior stay suture. A tie is made to start from; its end is left long, and is snapped by the mosquito on the posterior stay. The operator holds the stay suture toward which he is sewing in his left hand, while his assistant holds the stay from which he is sewing, applying enough pull so as to keep the section which is being sewed on the stretch. The third stay, which lies beneath, is slackened up and relieved of the weight of its snap, otherwise the under wall of the artery might be pulled up against the anterior, and the two sewn together. The assistant pulls up with his right hand the slack of the running suture, after each stitch is passed, so as to evert the edges and bring intima to intima. (If the operator prefers to sew away from, rather than toward himself, he ties the posterior stay so that the ends come out on his side, and starts the running suture just anterior to it. In this case the assistant, with his right hand across the table, will hold the two stays, and the surgeon will pull up his own slack.) About six stitches usually suffice for each of the three sections.

The first section being completed, the assistant takes the stay which the operator was holding, the operator picks up the next one, the handles of the clamps are directed to the

side of the assistant, so as to expose the next section, and the suture is continued. When this section is completed, the operator cuts close the stay which the assistant is holding, which is no longer needed. The assistant then passes the long end and the posterior stay, which are snapped together, under the artery. The clamp handles are directed back to the side of the assistant, so as to bring the third section into view. The suture is continued, the operator taking the stay which was passed under, and the assistant the other. This section being completed, the ends of the running suture are tied to each other and cut. The stays are cut and the clamps removed, the distal one first.

There is practically always leakage of blood in some amount, usually through the stay holes, which have been stretched by the pull upon the stay sutures. If the anastomosis is otherwise competent, this ooze will stop in a half minute, some loose gauze being applied over the site of operation. If more than gentle pressure is applied on the gauze, a thrombus is apt to form within the artery. Where there is no leakage, there is probably thrombosis, and the pulsation of the vessel will have disappeared below the anastomosis. In this case the thrombus may sometimes be broken up and sent along by massaging and "milking" the artery. If the artery "spurts" through one hole, where a stitch has cut through, for instance, the clamps may be reapplied and the hole sewed over, with some show of success. In case there is more than one tear, the anastomosis had better be cut out and performed over again.

The intestines are replaced, and the peritoneum and fascia of the abdominal wall are sewed up together with a running buttonhole stitch of Pagenstecher, and the skin likewise. No dressing is applied. The entire operation should take thirty-five minutes or less; the clamps should not be on longer than fifteen minutes.

The advantage of being prepared to apply this technic to human traumatic surgery is suggested by the following case, which we report through the courtesy of Dr. L. R. G. Crandon,

Assistant Visiting Surgeon, Boston City Hospital, who invited one of us to assist him in the treatment thereof.<sup>2</sup>

T. G., Syrian, was brought to the Relief Station of the Boston City Hospital at 4.30 P.M., April 23, 1911, by a police ambulance, with the story that he had been stabbed in the left groin. He was conscious, restless and pale, pulse 80, of small volume and low tension.

Just below Poupart's ligament on the left was a narrow, somewhat pouting, clean-cut slit in the skin about three-quarters inch long, running nearly transversely. There was considerable blood on the thigh and the clothes covering the thigh. About the wound was some swelling. No pulsation in the femoral artery or its branches below this point was made out.

The thigh was cleaned and shaved. On the passing of a director into the wound, to ascertain where to introduce a wick, active arterial hemorrhage ensued. The wound was packed, and a sterile dressing was applied with pressure. Heaters and blankets were ordered, and salt solution administered by rectum.

Patient was cold, restless, and weak for two or three hours, but then became more quiet, stronger, and warmer. There was no return of pulsation in the branches of the femoral artery. Operation was advised and accepted.

Operation, Drs. Crandon and Ehrenfried: Under ether an incision was made above and parallel to Poupart's ligament. The external iliac artery was found and a Crile clamp applied. An incision five inches long was made over and parallel to the femoral artery, the region of the punctured wound was laid open, and the dissection carried down to the femoral artery. This was found completely severed, though the ends were held together beneath by some strands of uncut adventitia. The surrounding tissues were infiltrated with blood-clot. The vein and nerve were intact.

Crile clamps were applied to the artery, the adventitia trimmed away, and the ends sewed together by the technic just described. The clamps were taken off, and then the clamp on the iliac artery was removed. There was some oozing of blood from the anastomosis, which ceased in two minutes under light pressure. Pulsation was readily felt beyond the suture.

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<sup>2</sup>We are indebted to Dr. Paul Thorndike, Surgeon-in-Chief, Boston City Hospital, for permission to publish the following record.

The abdominal wound was sewed up in layers, the thigh wound by mass sutures. Sterile dressing was applied. Stimulation, heaters and blankets.

The recovery was rapid and uneventful, despite the weakness of the patient from loss of blood. When seen the next day the left foot was warm, and on the day following pulsation of the *dorsalis pedis* could be readily made out, and heaters and blankets were discontinued. The temperature and pulse were normal on the fourth day, and remained so. On May 3 the stitches were removed, and on May 7 the patient went home, well except for a small granulating area at the site of the original wound.

We have applied this technic also in one case of transfusion, but without satisfaction. We consider the ordinary methods of transfusion, of which that of Elsberg is undoubtedly the best, more rapid and certain. The chief difficulties to suture in transfusion are the inequality in size of the vessels, their difference in texture, and the possibilities of tension under which the operation is performed. There is no question, however, but that the Carrel method of end-to-end anastomosis has already made for itself an important place in operative surgery.

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# LATERAL VASCULAR ANASTOMOSIS.

AN IMPROVED METHOD.

BY BERTRAM M. BERNHEIM, M.D.,

AND

HARVEY B. STONE, M.D.,

OF BALTIMORE, MD.

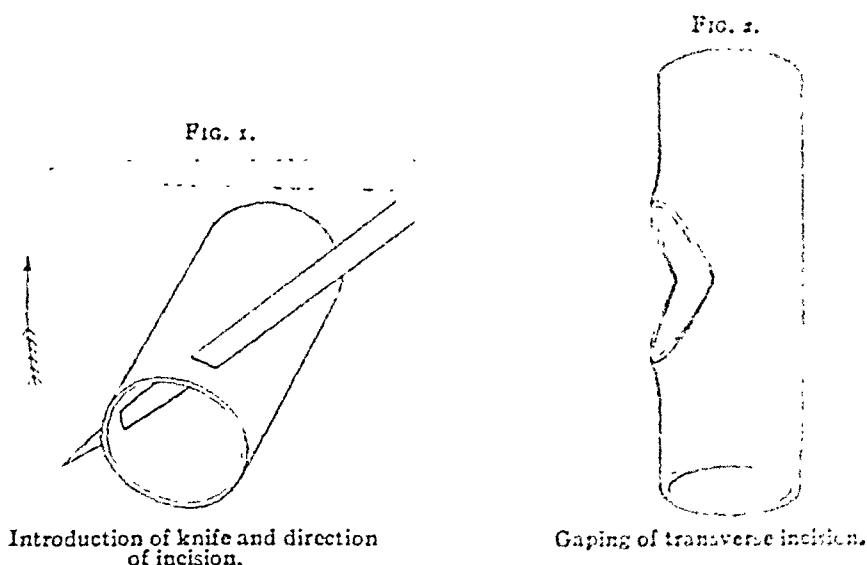
(From the Hunterian Laboratory of the Johns Hopkins University.)

IN the course of an experimental study of arteriovenous aneurisms, concerning certain physiological and surgical problems presented by these lesions, the method herein to be described was developed for making lateral anastomoses between blood-vessels. It is published because it seems superior to previous procedures, either for experimental or clinical purposes. A brief description is all that is necessary to supplement the illustrations.

The artery and vein between which the communication is to be established are carefully dissected out, and bull-dog or Crile clamps, rubber-shod, are applied to each vessel at corresponding points. The incision in the artery is made first. A sharp cataract knife, held transverse to the long axis of the vessel, is plunged through the artery in a direction oblique to the horizontal plane in which the vessel lies, so as to form a sector of the lumen with its arc equal to about one-third of the circumference. The knife is thrust in with its cutting edge upward and toward the adjacent vein. The overlying one-third of the artery wall is then divided (Fig. 1). At once the retraction of the longitudinal muscle and elastic fibres causes this transverse incision to gape and become an open ovoid (Fig. 2). Owing to the fact that the knife was entered obliquely and not perpendicularly, this ovoid looks toward the vein and also somewhat upward. The posterior edge of the opening is thus easily accessible for suturing. As soon as the artery is opened all blood is

washed out with salt solution, the adventitia stripped off carefully, and the lumen and other surfaces freely bathed with liquid vaseline. These are precautions common to all vascular surgery—thanks to Carrel—but demand restatement because of their importance. The artery is then protected with vaseline-soaked gauze, and a similar incision, corresponding in size and position, is made in the vein so that it looks toward the artery and upward.

The suture <sup>1</sup> is started by passing the needle through the wall of the artery from without inward, then crossing to the vein and passing here from within outward (Fig. 3).



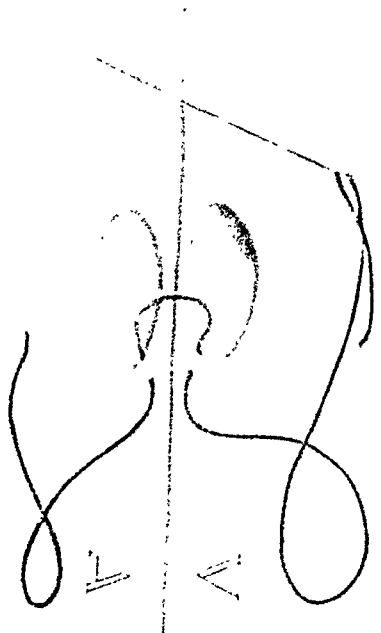
When this suture is tied the knot lies outside the vascular lumen (Fig. 4). From this starting point a simple continuous suture is carried around the openings in the two vessels (Figs. 5 and 6), care being taken to avoid purse-stringing. The operation is completed by tying the last suture to the remaining long end of the first tie. No difficulty is experienced in approximating the edges of the incisions, and there is no more tension on the thread than in an end-to-end anastomosis. After completion of the suture, the clamps are removed first from the vein, as in all vascular

<sup>1</sup>The suture material consists of a straight needle, size 12, ground down, and silk, size .00000, which has been sterilized in vaseline.

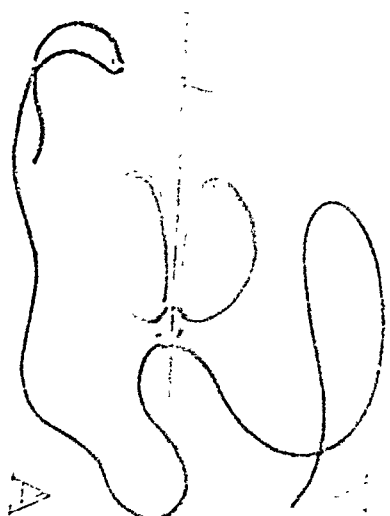
surgery. If any marked leakage occurs, the weak spots are reinforced by one or two extra sutures. Then the arterial flow is gradually allowed to go over. During the suturing, intima is not always approximated to intima, but with the establishment of the arterial stream through the anastomosis, the "pull" in opposite directions between the two vessels helps to bring about an accurate approximation.

This method has been employed with great satisfaction a considerable number of times in animals, and was equally simple in execution in the one clinical case in which we have so far had the opportunity to try it. After an interval now of three months, this patient's anastomosis is working splendidly. It is intended to report this case in detail later, with several other clinical cases in which other methods of arteriovenous anastomosis have been used. The rationale of this method has been deduced from a consideration of the cases of arteriovenous aneurism met with in the clinic. Previous laboratory anastomoses have been performed by making longitudinal incisions in the vessels rather than transverse. In the clinical cases following trauma there seems little doubt that the wounds are transverse. A bullet, knife-blade, or other object wounds the adjacent surfaces of artery and vein at the same level. The vessels are held closely together by their investing sheaths, the transverse incisions gape, as illustrated in these sketches, and the gaping lips soon adhere. The method described in this paper is practically a copy of this accidental anastomosis occurring in nature.

We think that this anastomosis, with a ligation of the vein on the cardiac side of the point of union, offers a much easier and safer method for reversal of the circulation than the present procedure of end-to-end anastomosis of artery and vein, with ligation of the proximal stump of the vein and the distal stump of the artery. When the latter method is used a failure of the anastomosis imperils the knee or elbow, owing to the complete division of the arterial trunk; and as a rule the disease process which leads one to do an



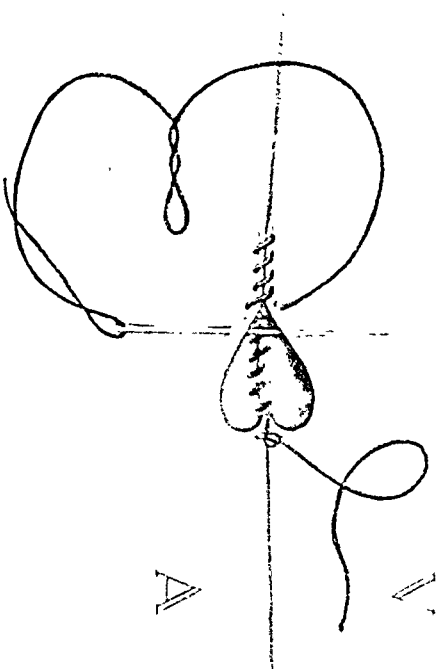
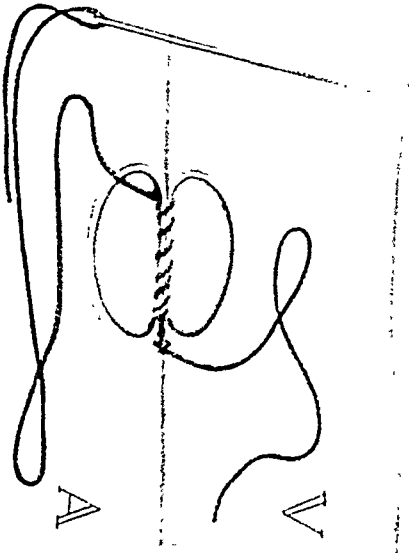
Initial suture placed.



Initial suture tied.

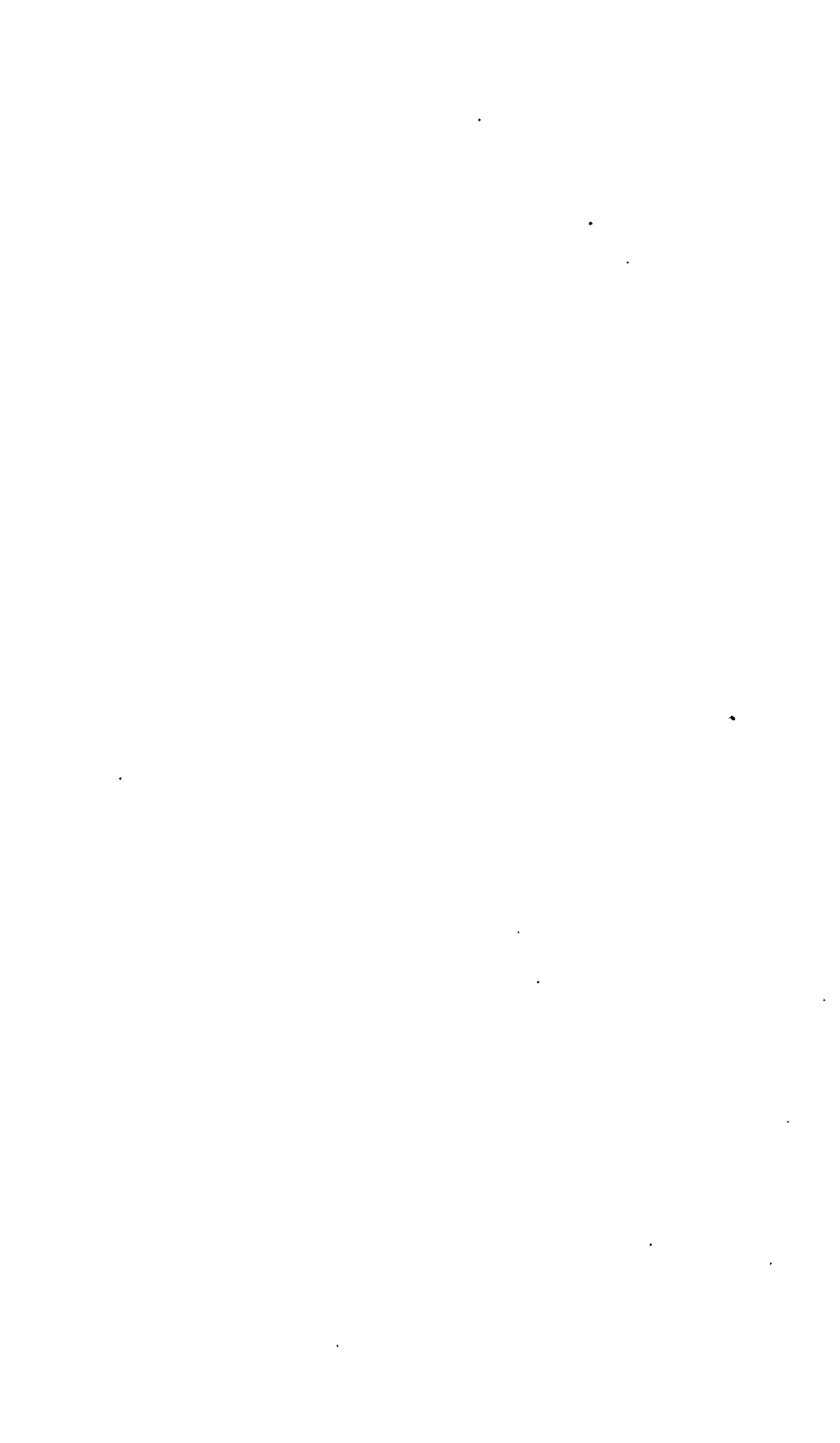
Fig. 6.

Fig. 5.



Finishing posterior part of continuous suture.

Posterior part of suture completed and about half of another.



arteriovenous anastomosis is not in itself so advanced as to threaten the larger joints. In the few experiments with the new method in which thrombi developed, they never obliterated the arterial lumen, but were entirely lateral. Moreover, by this procedure, the inflow of blood into a threatened extremity still has whatever arterial channels remain patent, and the venous trunk in addition may be utilized to carry some of the needed excess. It is important to ligate the vein above the anastomosis, to protect the heart from a direct back flow of blood under arterial pressure into its right chamber.

In brief conclusion, this method is presented because of its easy execution, making it superior to the longitudinal incision for experimental work, and because of its safety, making it better than the end-to-end for reversals of the circulation and other clinical conditions.

## SOME RECENT MECHANICAL AIDS TO HOLLOW VISCERAL ANASTOMOSIS.

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SUTURE methods in hollow visceral anastomosis have, in recent years, become so universal that they may practically be considered the method of choice. This is especially true with the through-and-through suture known as the Connell.

I have found it of advantage in lateral anastomosis to adopt Willard Bartlett's method of using two needles in the one catgut suture, placing the first stitch in the middle of the two approximating edges and approaching both angles early in the operation.

To successfully perform anastomosis with this method, holding clamps are necessary to fix the parts in close apposition during the operation. When two or more clamps are used for this purpose, it requires all the assistant's attention to keep the parts to be approximated in close apposition. More assistants in the field of operation brings added interference, and also increased danger of infection.

To obviate these objections we have, within the past few years, devised two instruments which we believe materially simplify the technic of visceral anastomosis.

One of these is the three-pronged compound clamp known as the "Roosevelt clamp," which was devised by my assistant, the late Dr. G. F. Roosevelt, and myself some six years ago. This clamp was designed solely for gastro-enterostomies, and with its several modifications is now quite generally in use and accomplishes several purposes.

First: It holds the parts to be anastomosed absolutely fixed in the position in which they have been placed, and no amount of manipulation can disarrange them.

Second: There is no need of the instrument being held.



FIG. 1.



Posterior gastro-enterostomy with the Ross esophagostomy clamp

FIG. 2.

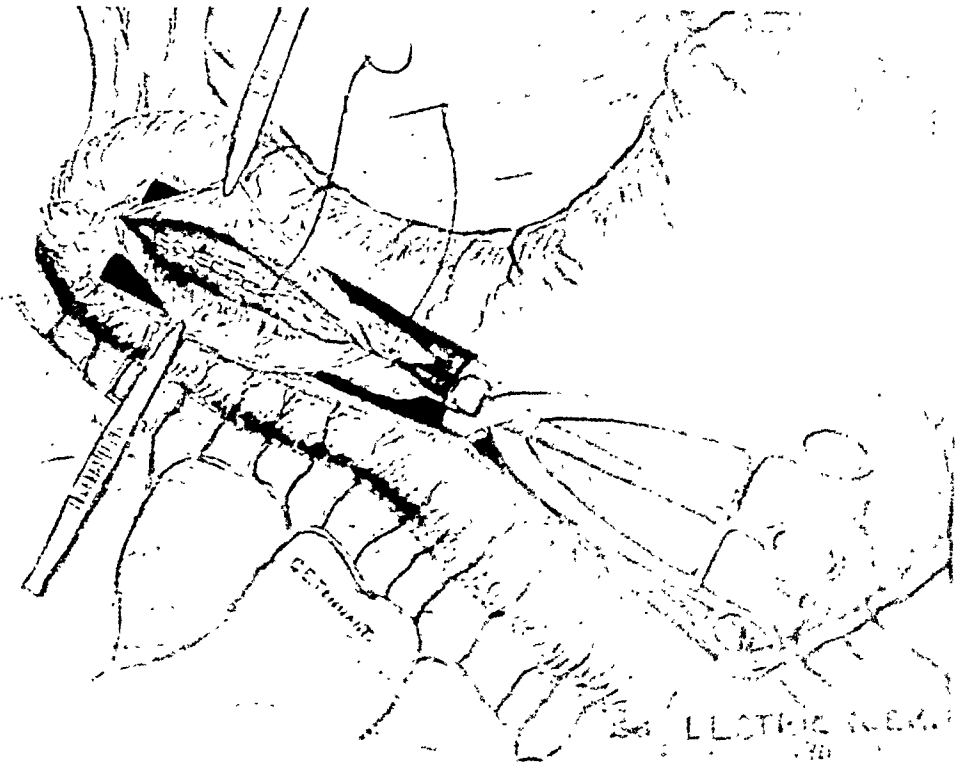
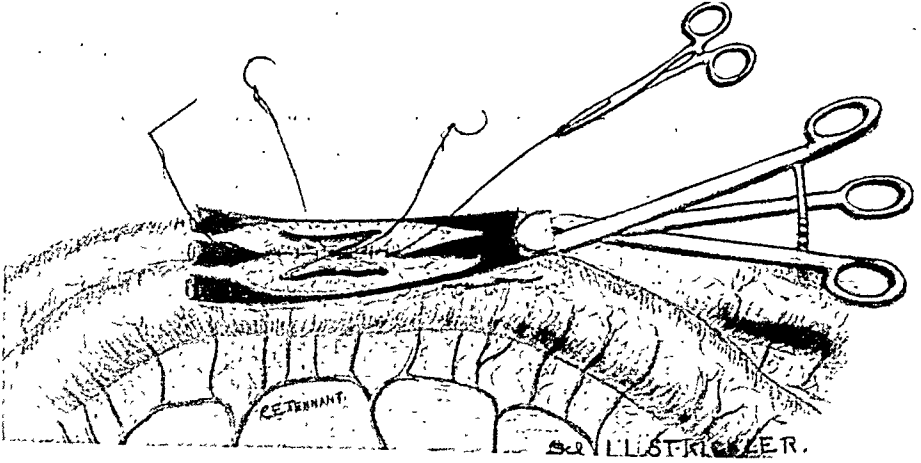
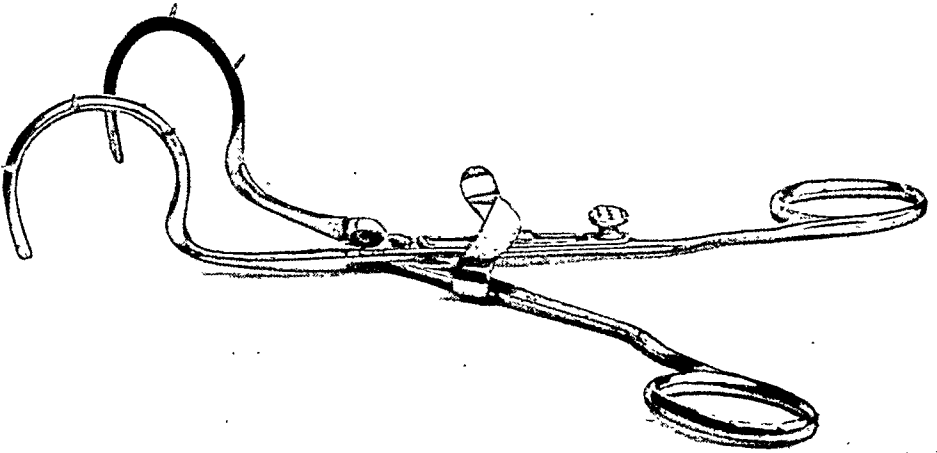


FIG. 3.



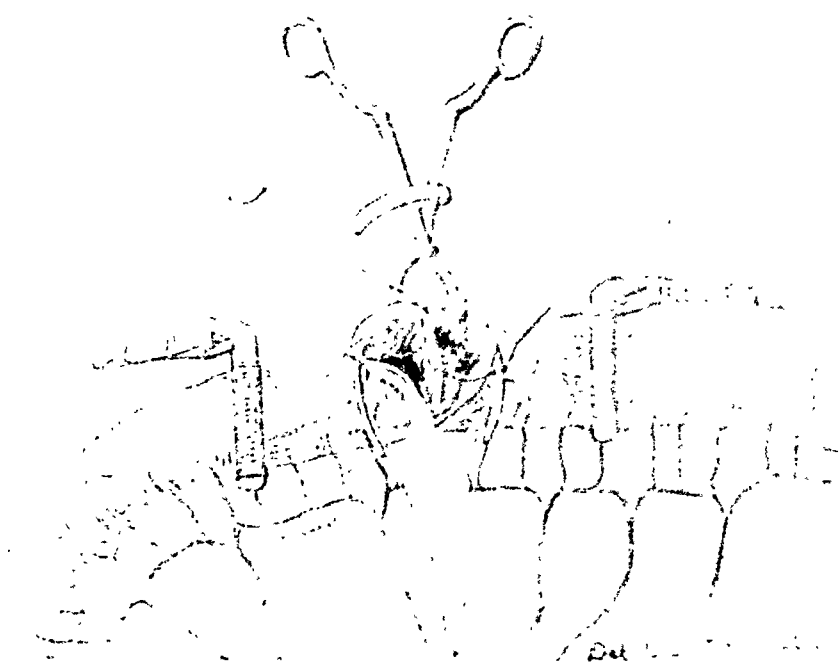
Lateral anastomosis.

FIG. 4.



Two-loop clamp for end-to-end intestinal anastomosis.

FIG. 5.



End-to-end suture anastomosis with help of clamp

FIG. 6



Anastomosing area, etc.



since it is heavy enough to lie on the patient's abdomen with the parts fixed in position, while the one assistant has both hands free to aid the operator (Fig. 1).

This clamp is, of course, adapted to either posterior or anterior operations. The same clamp with the straight prong is also extremely practical in the pyloroplasty of Finney (Fig. 2), and in gastric anastomosis after partial gastrectomy.

An imitation of this three-pronged clamp, called the "Lennartz clamp," followed about six months after the Roosevelt. It is a much lighter and smaller instrument, and I have found it especially practical for pyloroplasty and lateral intestinal anastomosis (Fig. 3). It, too, leaves the hands of the assistant free to aid the operator.

The second instrument is that of an end-to-end anastomosis clamp. While the use of end-to-end anastomosis is not practicable in every case, still my experience has been that where this form of anastomosis is made in the ileum and colon with suitable instruments, it can be accomplished in one-half the time consumed by a lateral anastomosis, and if the modern theories of Lane and others regarding the kinks, flexures, and stagnation are tenable, then the end-to-end anastomosis is far more consistent to employ than the lateral. These reasons alone, I believe, are sufficient to justify the more frequent employment of the end-to-end anastomosis when it can safely be accomplished.

The instrument to which I refer, and which I recently devised for this purpose, automatically holds the ends of the severed gut in an open and fixed position while suturing, and it also leaves the assistant's hands free for other work. The instrument is simple in construction and manipulation (Fig. 4).

The method, briefly described, is to pass the two ends of the intestines under the loops of the instrument, the handles of which point away from the operator. The intestine is then impaled on the three pins in their respective loops. When the loops are separated the dangerous mesenteric border is brought well up to the surface, where a curved needle with a long suture (preferably chromicized) is passed through both

ends of the bowel on the opposite side from the operator, and midway between the dome and the mesenteric border (Fig. 5). The suture is continued on around through the mesenteric border and up on the side nearest the operator until the dome is reached. The needle is then transferred to the loose end left for this purpose, where the suture was first commenced, and enters the peritoneal surface including all coats of the bowel.

The intestine is now released from the pins and the suture continued on over the dome, keeping well outside of the three perforations made by the instrument. The two approximated ends of the suture are then tied from the outside. It is surprisingly simple to anastomose the ends of unequal bowel with this instrument (Fig. 6), and the resulting infolding of the smaller gut into the larger is very much similar to the recent Gibson peritoneal invagination method.

The advantages of using this instrument are: (1) the safety of the complete circular suture; (2) the definite care of the dangerous mesenteric zone, and (3) the economy of bowel, since by this method it need be no more than an approximation.

# LIGATION OF THE FIRST PORTION OF THE LEFT SUBCLAVIAN ARTERY.

WITH REPORT OF A RECENT SUCCESSFUL CASE.

BY JAMES M. NEFF, M.D.,  
OF SPOKANE, WASH.

RECOVERY so rarely follows ligation of the first portion of the left subclavian artery, especially in the presence of severe infection, that I think the following case worthy of record.

CASE REPORT.—Mr. H. W., age twenty-three years, single. In December, 1909, patient first noticed an enlargement of the glands in the left side of the neck.

Patient entered the Deaconess Hospital, Spokane, on February 11, 1910. In left side of neck there was a chain of enlarged lymphatic glands extending from the mastoid process to the clavicle. The centre of the mass was more prominent, tender to pressure, and presented deep fluctuation. There was considerable periadenitis, the glands being adherent to each other and quite immovable. Examination of heart, lungs, and abdomen negative.

Operation, February 12, 1910: An incision was made, extending from the mastoid process downward along the anterior border of the sternomastoid muscle to the middle of the neck, then backward, severing the muscle, and continuing down to the clavicle along its posterior border. The chain of enlarged glands was reached through this incision, and their removal begun from below by clearing the space between the internal jugular vein and the clavicle. The glands and infiltrated gland bearing tissue in this situation was dissected free with some difficulty, but without apparent injury to any of the important structures in the neighborhood. The lower angle of the wound was then tamponed to produce distention of the internal jugular vein, and the dissection of the glands was continued in an upward direction. This was accomplished with a good deal of difficulty, owing to the extensive periadenitis and suppuration in the centre

of the mass. It was finally completed, however, and we were about ready to close the wound, when there was a sudden gush of blood from the lower part of the wound behind the clavicle. The hemorrhage was very profuse and came on without the slightest warning, as we had been working in the upper part of the neck and had not touched the lower portion since the beginning of the operation. The flow of blood was stopped by pressure with the fingers behind the clavicle, and the field cleared by sponging. An examination was then made and it was found that the hemorrhage had come from the subclavian artery just internal to the scalenus anticus muscle. By cautiously moving the fingers inward, the outer border of the small opening in the artery was revealed. A hæmostat was then placed on the vessel in this situation and two more to the inner side of the first, thus closing the opening. The wound in the neck was now closed in the usual manner, after uniting the cut ends of the sternomastoid muscle with catgut sutures. A drainage tube was placed in the upper part of the wound on account of the secondary infection, and the hæmostats were allowed to protrude through the lower angle of the incision.

Patient was returned to bed in fair condition, with pulse 110 and temperature 100.8° F.

On February 14, 48 hours after operation, the hæmostats were carefully removed and two moderately firm gauze packings were inserted, one upon the other behind the clavicle and down to the artery. No bleeding occurred immediately after the removal of the forceps, but three hours later the patient had a very severe hemorrhage which stopped spontaneously. The outer packing was then removed and replaced by a firmer one, which was held in position by a tight adhesive plaster drawn across the wound and over the shoulder. After the hemorrhage the patient was anæmic and pulse went up to 118. On February 18, four days later, there having been no hemorrhage in the interval, the outer packing was removed, but the one next to the artery left undisturbed. The wound looked well, though there was slight purulent discharge from the upper part through the drainage tube. Pulse 112, temperature 101.6° F. Early the next morning, 11 hours after the last dressing, patient had another very severe hemorrhage. On the 19th he became delirious and on the 20th had two more hemorrhages. From this



date until the 25th, there were no hemorrhages, his pulse went down to 98, temperature nearly to normal, and we were greatly encouraged about his condition. On February 25 another severe hemorrhage occurred, and between this date and March 4, a period of seven days, he had fourteen hemorrhages of greater or less severity. During this time the temperature ranged from 99.6° to 101° F. On February 27 cultures were taken by Dr. Frank Hinman from the pus in the drainage tube for the purpose of making autogenous vaccines. On this date, slight edema of the arm and weakening of the radial pulse were noted, the result of long-continued pressure on the subclavian artery. On March 3 Dr. Hinman injected 150,000,000 bacteria in right arm. On March 4, condition of patient became so grave that we decided that his only hope lay in the ligation of the first division of the subclavian. This procedure had been considered several times before, but as we had been unable to find in the literature the report of a single successful case of ligation of the first portion in the presence of sepsis, we had looked upon the operation as a last resort. At the time we decided to ligate the artery our patient had a temperature of 103.6° F., pulse 160, and he was delirious from anæmia and sepsis. For five hours before the operation we kept up continuous digital compression of the artery, as the hemorrhage would recur whenever the pressure was released.

Operation, March 4, 1910, 7.30 P.M.

Before beginning the operation an intravenous saline transfusion was given in the median basilic vein of the right arm.

An incision was made along the upper border of the clavicle, from the outer third to the sternoclavicular articulation and then upward for  $2\frac{1}{2}$  inches through the old incision along the posterior border of the sternomastoid. An abscess cavity containing several drachms of foul-smelling pus was found beneath the latter muscle. The clavicle was divided with bone-cutting forceps  $1\frac{1}{4}$  inches from the sternum, and the ends retracted in a downward direction, thus giving good access to the subclavian space. Up to this time pressure on the subclavian had been maintained, but when all was in readiness the pressure was released and the packing removed. A gush of blood immediately followed but was at once controlled by direct pressure with the fingers, followed by the application of hæmostats to the opening

in the artery. The scalenus anticus was next divided, the thyroid axis and vertebral artery recognized, and the subclavian dissected free in a downward direction from the surrounding structures. The dissection was particularly difficult because of the previous operation and the infection of the field, which had caused a matting together of all the tissues. By careful work, however, the subclavian and innominate veins were isolated and drawn forward and the thoracic duct recognized and separated from the artery. After the vessel was completely isolated, two attempts were made to ligate it in the upper portion of the first division, but both ligatures cut through the outer coats and had to be removed. Finally three-quarters of an inch above the aorta the wall was strong enough to tolerate a ligature, and a double strand of medium sized silk on an aneurism needle was passed from below upward, behind, and around the vessel. This double ligature was tied in a simple square knot (not the Ballance and Edmunds stay knot) just tight enough to occlude the artery and stop pulsation. A hæmostat was then clamped on the vessel about one-quarter inch distal to the ligature. Another double silk ligature was tied around the artery distal to the opening in its wall and a second hæmostat applied proximal to it. The thyroid axis, vertebral, and internal mammary arteries were then ligated with silk and the forceps removed from the wound in the subclavian. A loose packing of iodoform gauze was placed in the deep cavity behind the clavicle, the ends of the clavicle united with aluminum bronze wire, and the external wound closed with interrupted silkworm gut sutures.

When patient was returned from the operating room, his pulse was 140 and temperature 103° F. For ten days after operation the blood-pressure was kept below 112 mm. of mercury by diminishing the amount of ingested liquids and giving spirits of nitroglycerin whenever it reached that point.

Restlessness was controlled by hypodermics of morphine. Five days after operation the autogenous vaccines were again given and repeated every three or four days thereafter. The temperature ranged from 100.2° F. to 104.2° F. and pulse 120 to 150, until March 19, fifteen days from time of operation, after which both gradually went down to normal. Patient continued delirious at intervals until March 15. The hæmostats were removed from the ligated vessels on March 13, nine days after

operation. On March 13, he developed a right-sided pleurisy and cough, with yellowish expectoration. His temperature was 103° F. to 104° F. and pulse 130 to 140 for a few days, but the trouble entirely subsided within a week. On March 19 the ends of the clavicle, which had become separated, were reunited. He was allowed out of bed for the first time on March 20, sixteen days after operation. The wound, which was infected at the time of operation, continued to suppurate until the patient left the hospital on April 2, although it filled rapidly with granulations and was about flush with the clavicle at the time of his discharge.

The radial pulse disappeared when the artery was ligated and has not returned to date, sixteen months after operation.

The peripheral circulation remained good after the ligation and the hand and arm were warm at all times.

Marked atrophy of the arm, forearm, and hand took place during the two or three months following operation, and there was great weakness of all the muscles of the left upper extremity from shoulder to fingers.

Tactile and pain sense were abolished over the lower third of the forearm, hand, wrist, and fingers for four months, and muscular sense in the hand was greatly impaired for the same time.

As a result of almost constant exercise, frequent massage, and faradic electricity to the weakened and atrophied muscles, the muscular power is now about normal and the muscles have regained their normal volume and tone. There still remains, however, slight impairment of tactile sense in the tips of the fingers. The general health of the patient at the present time is perfect, weight up to normal, and he is able to attend to his regular business affairs.

This case presents a number of interesting features. First The manner in which the artery was injured. We had finished our dissection in the subclavian space, apparently without injury to any important structure, and in fact had completed the entire operation when the hemorrhage suddenly occurred without apparent cause. The only possible explanation was a weakening of the vessel wall produced during the separation of the adherent glands and infiltrated gland-bearing tissue.

Second: The youthfulness of the patient. This was undoubtedly an important factor in the successful outcome of the case, as statistics show that the large percentage of recoveries after ligations of the great vessels occur in young individuals, due probably to the greater elasticity of the vessels. It is well known that healthy elastic vessels tolerate ligation better and are less likely to cut through than diseased ones. Collateral circulation is also more readily developed in them, as they offer less resistance and distend more easily.

Third: The favorable influence of the autogenous vaccines. So far as can be learned from a study of the literature this is the first successful case of ligation of the first surgical division of the left subclavian artery, where the operation was performed in an infected field and the wound continued to suppurate afterward. In view of this fact we are inclined to attribute to the use of the vaccines a part, at least, of the credit for the recovery of the patient. The culture from the pus taken by Dr. Hinman on February 27 showed the '*Staphylococcus aureus* and *albus* and the '*Streptococcus*. A vaccine was made from each of these organisms after the method of Wright, mixed and counted. From March 3 to April 5 injections of the vaccines, ranging in amount from 150,000,000 to 550,000,000 bacteria, were given every two or three days.

Fourth: The application of hæmostats distal to the proximal ligatures and proximal to the distal ligatures, and the retention of them in place for nine days after the operation. Just how much this had to do with the favorable result we are not prepared to say, as we are unable to find in the literature any record of a case similarly treated. The flexible bladed forceps were placed close to the ligatures and probably took some of the strain from the ligated portion, as the silk was tied just firm enough to obliterate pulsation and not sufficiently tight to injure the intima.

Fifth: The influence of long-continued pressure on the artery before operation upon the development of efficient collateral circulation. This was probably another important

factor in bringing about a successful result. It will be noticed in the record that from the time we removed the hæmostats, two days after the first operation, until the date of the ligation, a period of eighteen days, there was practically continuous pressure on the vessel. This pressure was exerted through the gauze packing most of the time and was sufficient to cause œdema of the arm on February 27, and weakening of the radial pulse on February 28. This continuous pressure undoubtedly had much to do with the development of the collateral circulation prior to the ligation of the artery. The only evidence of severe disturbance of nutrition in the extremity after the ligation was a very small painless perforating ulcer in the tip of the middle finger. This came on about three weeks after operation, perforated to the bone, and then promptly healed.

A few words here in regard to the surgical anatomy<sup>1</sup> of the subclavian artery may not be out of place. The relations of the second and third portions are the same on both sides, while those of the first division differ on the right and left. This is due to the fact that the right subclavian is given off from the innominate and the left arises direct from the aorta. The right vessel is three inches long, and arises just behind the right sternoclavicular joint. The first portion, internal to the inner border of the scalenus anticus, has in front of it the right vagus nerve, the cardiac branches of the vagus and sympathetic, and the internal jugular and vertebral veins. Behind it are the recurrent laryngeal nerve and the apex of the right pleura. The left subclavian artery is four inches long, and arises from the aorta behind the lower part of the manubrium sterni. The first portion, internal to the scalenus anticus, is in relation anteriorly with the following structures: The left vagus nerve, the left superior cardiac branch of the sympathetic, the left inferior cardiac branch of the vagus, the left phrenic, and the left common carotid artery. It is crossed obliquely by the left innominate vein above and is overlapped on the left side by the left lung and pleura. Posteriorly it is in relation on the inner side with the left margin

of the œsophagus and the thoracic duct and on the outer side with the pleura. Internally it is in relation from below upward with the trachea, the left recurrent laryngeal nerve, the œsophagus, and thoracic duct. Externally it is closely invested by the left pleura.

*Collateral Circulation.*—When the artery is ligated in its first portion distal to the origins of the vertebral, thyroid axis, and internal mammary arteries, the collateral circulation takes place through the following anastomoses:

1. Branches of the suprascapular (from thyroid axis) with the superior thoracic (from first part of axillary).
2. Between the internal mammary and the superior thoracic.
3. Between the suprascapular and the acromiothoracic (from second part of axillary).
4. Between the internal mammary and the acromiothoracic.
5. Between the posterior scapular branch of the transverse cervical (from the thyroid axis) and the subscapular (from third part of axillary).
6. Between the suprascapular and subscapular.
7. Between the acromial branches of the suprascapular and the posterior circumflex (from third part of axillary).
8. Between the intercostals and the pectoral branch of the acromiothoracic.
9. Between the intercostals and the long thoracic (from second part of axillary).

If the ligature be applied to the subclavian proximal to the origins of the vertebral, thyroid axis, and internal mammary arteries, the collateral circulation will develop as follows:

1. Between the intercostals and the pectoral branch of the acromiothoracic.
2. Between the intercostals and the long thoracic.
3. Between the lateral branches of the intercostals and the subscapular.
4. Between the aortic intercostals and the anterior intercostal branches of the internal mammary.

5. Between the inferior phrenic (from the aorta) and the musculophrenic branch of the internal mammary.

6. Between the deep epigastric (from the external iliac) and the superior epigastric (from the internal mammary).

7. Between the deep branch of the princeps cervicis (from the occipital artery) and the superior intercostal (from first portion of subclavian on left side and the second portion on the right side).

8. Between the occipital (from the external carotid) and the ascending cervical branch of the inferior thyroid (from thyroid axis).

9. Between the ascending pharyngeal (from the external carotid) and the ascending cervical branch of the inferior thyroid.

10. Between the œsophageal branches of the thoracic aorta and the œsophageal branches of the inferior thyroid.

11. Between the superior thyroid (from the external carotid) and ascending terminal branches of the inferior thyroid.

12. Between the inferior thyroid of the opposite side and the inferior thyroid of the same side.

13. Between the arteria princeps cervicis (from the occipital) and the superficial cervical artery (from the transverse cervical).

14. Between the dorsal branches of the intercostals and the posterior scapular branch of the transverse cervical.

15. Between the occipital artery (from the external carotid) and the muscular branches of the second part of the vertebral.

16. Between the princeps cervicis and the anastomotic branches of the third part of the vertebral.

17. Between the right and left vertebral arteries through the circle of Willis.

It will thus be seen that the opportunities for the development of collateral circulation are numerous, whether the ligature is applied proximal or distal to the origin of the branches. This fact explains why gangrene so seldom follows ligation of the artery.

An important factor in the establishment of collateral circulation after ligation of the great vessels is the increased pressure in the general circulation and the lowered pressure in the segment beyond the ligature.

The time of return of the radial pulse varies greatly in different cases, depending upon the number and efficiency of the collaterals. In some cases, however, where the circulation continues perfect, so far as nutrition is concerned, the radial pulse never returns. In one case reported by Koch it was felt immediately after the vessel was tied, in two cases in the first twenty-four hours, and in twelve cases during the first five days. In the remainder the pulse returned later, in one after six months.

In most of the cases, the temperature of the ligated side is lower than that of the other, but in a few it has been higher.

Sir Astley Cooper attempted to tie the first portion of the left subclavian artery in 1809, but abandoned the operation, thinking that he had injured the thoracic duct. The first ligation of the vessel on record was done by Colles in 1815.<sup>2</sup> The patient died. Dr. J. Kearney Rogers of New York ligated the first portion on the left side in 1846.<sup>3</sup> His patient died of hemorrhage on the sixteenth day. Halsted, of Baltimore, in 1892<sup>4</sup> successfully tied the first portion on the left side for aneurism of the subclavian and axillary arteries, and in 1898 performed another successful ligation while removing a tumor from the subclavian region, Dr. John C. DaCosta ligated the vessel twice, with recovery of both patients, and Nassau, of Philadelphia, successfully ligated it in its first division for aneurism of the third portion. B. F. Curtis in 1897 and Allingham in 1899 both reported successful cases.

The mortality statistics of ligation of the subclavian vary greatly, depending upon whether the cases were tabulated before or after the aseptic era. Thus Polland's statistics show that in the pre-antiseptic era ligation of the vessel, regardless of the portion ligated, gave a mortality of 70 per cent. The best results were obtained in the third portion. The first division was ligated eleven times with eleven deaths. Since



the beginning of the antiseptic era, however, the mortality has been only 22 per cent., irrespective of the portion ligated. H. Lilienthal<sup>5</sup> secured notes on 89 cases of ligation of the subclavian for aneurism before 1890. The mortality rate from all causes for the entire number, irrespective of the portion of artery ligated, was 52.8 per cent. He further states that the mortality of ligation of the first portion of the vessel on the right side has fallen from 75 per cent. in 1890 to 10 per cent. in 1906. He attributes this diminution in mortality to the use of the stay knot of Ballance and Edmunds.

According to Koenig, the first portion of the right subclavian has been ligated 20 times with one recovery, death being due to secondary hemorrhage in the great majority of cases. Asthurst collected 19 cases of ligation of the first portion with a mortality of 100 per cent, one patient dying on the thirty-sixth day. Sir J. C. Erickson gives a table of 14 cases operated on with 14 deaths. Deaver, in 1889, reported 16 cases with 13 deaths, and Bryant, 21 cases with 19 deaths. J. D. Bryant<sup>6</sup> in his "Operative Surgery" states that the subclavian artery has been ligated in its three divisions 250 times with 134 deaths. Jacobstahl<sup>7</sup> collected 47 cases of proximal ligations for aneurism, of which eight were of the first division. Seven of the eight cases died, five from hemorrhage, one from exhaustion, and one from rupture of the sac. Of the eighteen cases of ligation of the first portion collected by Wyeth all ended fatally. In five of these, the common carotid was also tied. Death was due in most cases to hemorrhage from the distal segment of the artery.

*Causes of Death.*—By far the most frequent cause of death is secondary hemorrhage, which may occur at any time from the end of the first week to the sixtieth day. If the wound continues to discharge after the operation, the patient is not out of danger until the sinus closes, no matter how long it may remain open. This is doubtless due to the fact that the sinus is kept open by the ligature material acting as a foreign body, which therefore maintains an open tract from the artery at the point of ligation to the surface of the body. Furthermore, as this sinus is always infected, we have the

added danger of sepsis, with possible ulceration of the ligature into the lumen of the artery and consequent fatal hemorrhage.

Secondary hemorrhage is probably also favored by tying the ligature too tight and thus injuring the intima. Halsted thinks that if the coats of the artery were not divided but merely compressed by the ligature, and if absorbable material were used instead of silk, the mortality would be much lower. H. Gilbert Barling<sup>8</sup> shares this opinion with Halsted. J. A. Blake<sup>9</sup> also thinks that there would be little danger of late hemorrhage if the ligature did not injure the intima. A ligature tied with the ordinary knot is more likely to ulcerate through the wall at the position of the knot than one tied after the method of Ballance and Edmunds. This method consists of passing two separate strands of ligature material around the vessel, tying each in a simple knot in the same direction, and then, by using the two strands on each side as one, completing the square knot.

A diseased condition of the vessel wall is another very important cause of secondary hemorrhage, and is one of the chief factors concerned in the late bleeding that occurs after the ligation of the great vessels for aneurism. Arteriosclerosis, syphilis, and local sepsis are the principal lesions which we meet with in this connection. If, on the other hand, the walls of the artery are healthy and the vessel elastic, there is less tendency for the ligature to cut through. This is due to the fact that the local pressure is better resisted and the collateral circulation develops more rapidly than in diseased vessels.

The primary and determining cause of secondary hemorrhage, however, is the enormous intravascular pressure which is constantly pounding against the blind end of the vessel. Naturally, then, the nearer the ligature to the heart the greater the pressure and the more likely it is to cut through (Oberst).

Secondary hemorrhage may take place either from the proximal or distal end when the vessel is ligated in continuity. Oberst<sup>10</sup> states that it is usually the distal end which bleeds after the ligature cuts through, the central end often being

thrombosed. It would seem, therefore, that the application of two separate ligatures, a short distance apart, would give greater security against this accident when the vessel is ligated in continuity.

Sepsis is another frequent cause of death, as is shown by the statistics of the pre-antiseptic era. It may prove fatal, first, by inducing a general septicaemia; second, by setting up a diffuse mediastinitis; third, by causing a septic thrombus in the ligated vessel, with septic emboli in different parts of the body; or, fourth, by favoring ulceration of the ligature into the lumen of the vessel and thus causing secondary hemorrhage. Oberst says that if sepsis is present, the patient is doomed to die and that attempts at secondary ligation in an infected field are almost always futile. Sepsis, the result of gangrene of the limb, may also figure as a cause of death.

Shock, pneumonia, pulmonary embolus, cerebral embolus, air embolism from injury of the internal jugular, subclavian, or innominate veins, and injury to the pleura and thoracic duct, have all been mentioned as causes of death after ligation of the first portion of the subclavian artery.

It is a remarkable fact that gangrene rarely follows ligation of the subclavian artery, and is accounted for by the abundant anastomoses and numerous collaterals on both sides of the ligated portion. Cases have been reported, however, where gangrene of the entire upper extremity followed the operation, and others where the fingers or portions of the hand have become necrotic. E. Wolff<sup>12</sup> reports from the clinic of Dr. E. Lexer 12 cases of ligation of the subclavian artery (part not specified) with two cases of gangrene. One of these was a traumatic aneurism of the subclavian and the other an aneurism of the radial artery, where the brachial was first ligated and later the subclavian.

Rotter collected seven cases of ligation of the subclavian artery, in one of which the vein was also tied. In none of these did necrosis develop. Jacobstahl quotes Peires's statistics of surgically treated aneurisms of the innominate artery. There were 72 cases treated as follows: first, ligation of the right subclavian or axillary—five times with recovery in all

cases; second, ligation of the right subclavian or axillary and right common carotid—65 times with recovery in 37. Among the 42 cases that recovered there was one of gangrene of the right arm, 2.4 per cent. The older statistics of Koch give 212 ligations of the subclavian above the clavicle, or of the innominate, with three cases of gangrene of the arm and four of necrosis of the hand or separate fingers. In 45 ligations under the clavicle there were no cases of gangrene.

According to Von Bergmann, in 90 ligations of the subclavian artery for gunshot wounds (1877) there were no cases of gangrene of the arm, and in only three was there necrosis of the fingers. In the latter cases the injury was very severe.

Five cases of ligation of the subclavian artery with five recoveries have been reported during the past five years.<sup>5 9 12 13 14</sup> All of these operations were done for aneurism of the right subclavian or innominate arteries, and all of the patients were over forty years of age; one was sixty-three. In one case, the circulation of the arm was poor at first, but improved soon after the operation, and in another there was slight cyanosis for a time. There was no necrosis in any of the cases. Chromic catgut was the ligature material used in three of the cases, and silk in one.

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# FIBRO-EPITHELIAL TUMORS OF THE MAMMARY GLAND.

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THIS communication is based upon the study of 44 breast tumors which were obtained from the operating rooms and laboratories of the Massachusetts General Hospital.<sup>1</sup> Microscopic sections of each tumor were available for study, and the gross specimens in many cases were preserved or photographed. The clinical data were obtained from the hospital records and from personal communications from the surgeons in charge. The pathological condition was made the prime consideration in dividing and classifying the cases in different groups, but the clinical data for each group have been collected and analyzed to distinguish so far as possible the symptomatology and differential diagnosis of the different forms of tumors.

The classification of breast tumors published by Dr. J. Collins Warren<sup>2</sup> makes of the fibro-epithelial tumors of the

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<sup>1</sup> The writers would here express their thanks to Drs. C. B. Potter, J. C. Warren, H. H. A. Beach, A. T. Cabot, J. W. Elliot, M. H. Richardson, F. B. Harrington, S. J. Mixer, W. M. Conant, C. L. Scudder, J. G. Mumford, F. G. Balch, Hugh Williams, Hugh Cabot, Lincoln Davis, and Dr. A. P. Torrey for the use of their material, and to Drs. W. F. Whitney and J. Homer Wright for assistance in collection of specimens and much valuable criticism.

<sup>2</sup> J. Collins Warren: Jour. Amer. Med. Assn., July 15, 1905. *Fibro-epithelial Tumors*.—(a) Fibrous type: 1, periductal fibroma; 2, periductal myxoma; 3, periductal sarcoma. (b) Epithelial type: 1, fibro-adenoma; 2, papillary cystadenoma.

mammary gland two main types, (a) fibrous, and (b) epithelial, according to the preponderance of one or the other tissue. This distinction is important from a clinical point of view on account of the greater predisposition to malignancy which is shown by tumors of the epithelial type. The tumors of the fibrous type are those in which the connective tissue preponderates over the epithelium. They are mixed tumors, like the other intrinsic tumors of the mammary gland, and contain both epithelial ducts and fibrous stroma, but because of the preponderance of the fibrous stroma and its similarity to, and probably origin from, the fibrous tissue immediately surrounding the ducts of the gland, they have been called by Dr. Warren "periductal tumors." In the Warren classification they are divided, according to the cell characteristics of this fibrous tissue, into three groups: periductal fibroma, periductal myxoma, and periductal sarcoma. It is the tumors of these three groups, together with those of the fibrocystadenoma group of the epithelial type that form the basis of this communication.

#### PERIDUCTAL FIBROMA.

There were 27 cases which come under the classification of periductal fibroma in this series. These tumors correspond in gross and microscopic pathology and in clinical characteristics with tumors which have been reported by other writers by a variety of different names, such as "chronic mammary tumor," "cystosarcoma," "intracanalicular papillary fibroma," "fibroma," "adenofibroma," "fibro-adenoma," "intracanalicular myxoma," "adenocoele," etc., a sufficient indication of the confusion which has existed in the minds of different pathologists and surgeons with regard to the assignment of these tumors to their proper category.

The pathological characteristics of the 27 periductal fibromata were as follows: 20 were single tumors; 7 were multiple. The size of the tumor varied in this series from that of a small marble to a mass as large as an orange. The tumors affected the right and left breasts with equal frequency, and in two

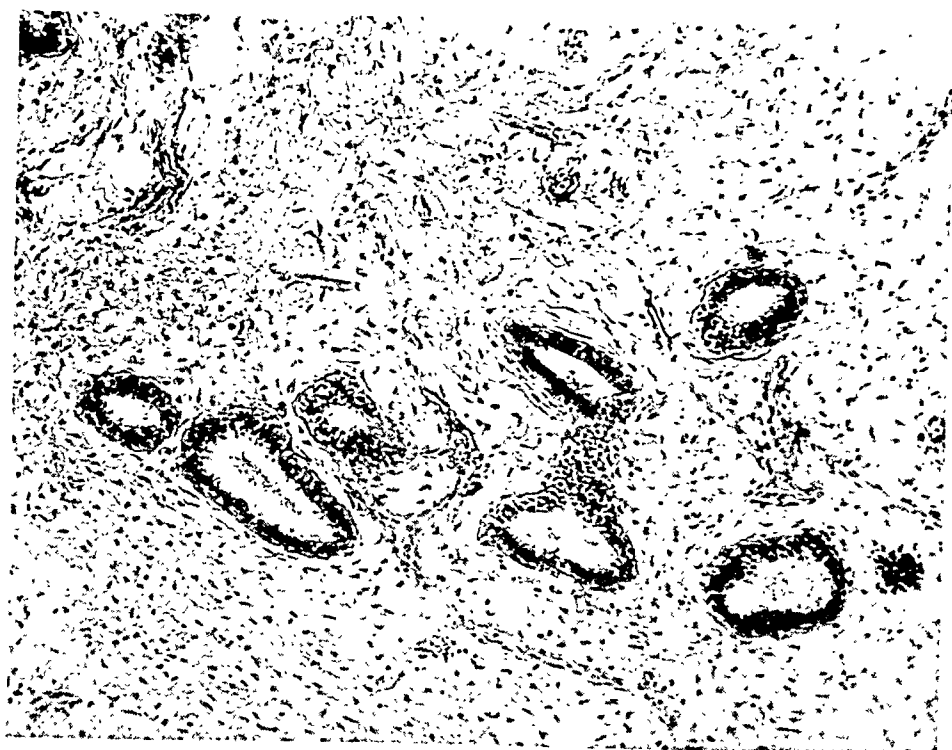


Periductal fibroma. Dissociated lobulation. Note small accessory duct and slender stalk. (Warren Museum)



Periductal fibroma. Intracanalicular type. Low power view showing dense fibrous tissue, and dense interlobular connective tissue.

FIG. 3.



Periductal fibroma. High power, showing loose periductal fibrous tissue and ducts.  
Resemblance to myxomatous connective tissue due to œdema.



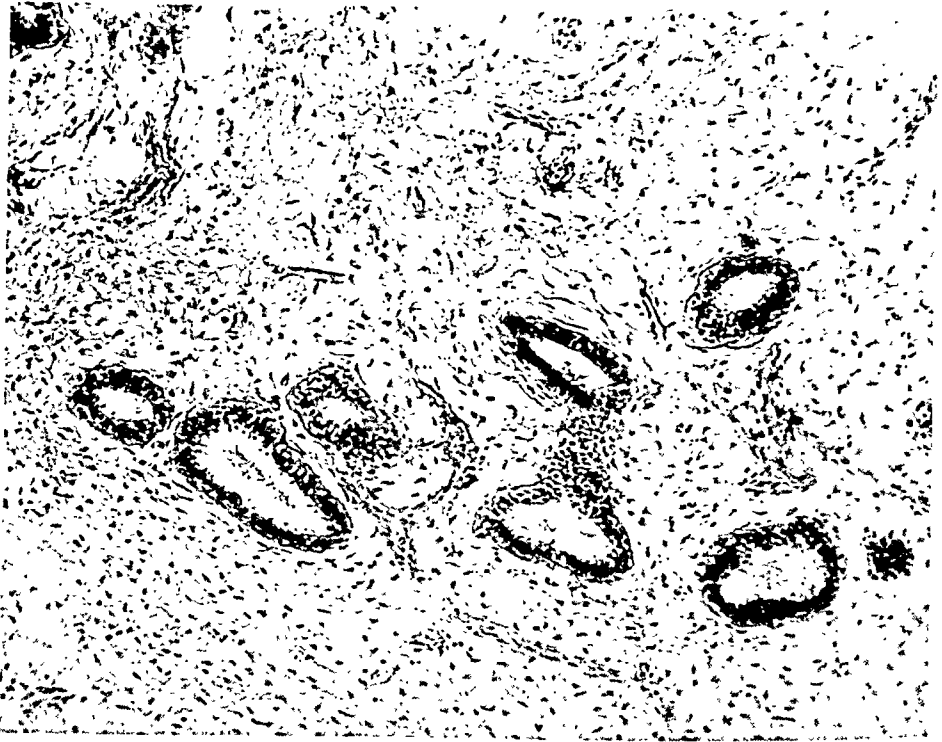
cases there were tumors on both sides. Sixteen of the 27 were in the outer hemisphere against 8 in the inner hemisphere, and 13 in the upper against 8 in the lower half of the breast; 2 occupied a central position beneath the nipple and areola.

In contour the periductal fibroma is generally irregularly rounded and lobular. Small tumors by their rounded form and elastic consistency may closely resemble a cyst imbedded in the breast tissue. The consistency of the larger tumors, however, is distinctly hard and fibrous, although occasionally degenerative changes or cyst formation may produce perceptible softening of the tumor mass.

From the rest of the breast tissue the tumors of the periductal type are clearly separated by a distinct capsule. This is one of their most distinguishing characteristics. Some tumors in their earlier stages of growth possess a remarkable mobility, and can be slipped about from one place in the breast to another, by reason of the absence of infiltration in the surrounding tissues external to the capsule. Only in the rarest instances and in the case of the largest tumors, is there any indication of adherence to the skin or to the underlying structures, and then as a result of an inflammatory process such as may be produced by irritant applications or by the various forms of degeneration.

On section these tumors present an irregular surface, gray-white to pink in color, with either clefts or pearly translucent areas scattered here and there. Strands of dense connective tissue dividing the whole tumor into lobular masses are frequently observed. In many tumors an edematous condition of the fibrous tissue, both gross and microscopic, occurs, which produces a gelatinous appearance and has led to their classification as myxomata by certain writers. The pearly translucent spots on the cut surface are the divided ducts and lobules of the tumor, and clefts and small cysts are not infrequently produced by the distortion or blocking of these ducts. In large tumors the cleft formation may be so pronounced as to give the appearance of a large cyst nearly filled with many rounded papillary outgrowths of fibrous tissue projecting from its walls (intracanalicular papillary fibroma).

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On microscopic examination these tumors are composed of a stroma of fibrous tissue, through which pass epithelial-lined gland ducts, cysts or clefts. The fibrous tissue is itself divided into lobular masses by bands of dense connective tissue which form the framework of the whole tumor and support the blood-vessels and lymphatics. The whole mass is thus to be compared to a distorted replica of one of the racemose gland lobules of the mammary gland. The fibrous tissue which forms the bulk of the tumor is similar to that which immediately surrounds the ducts in the adolescent breast to which attention was first called by Billroth, and more recently by Warren. This tissue is delicate and rich in nuclei as compared to ordinary connective tissue and its cells have more oval and vesicular nuclei. It also appears to be more succulent, and its fibres are often separated by collections of fluid, which give it an œdematous appearance and produce marked variations in the color reaction in specimens stained with hæmatoxylin and eosin.

The epithelial elements of the tumor appear on microscopic examination as epithelial-lined ducts, or cysts, or clefts. Their number and character vary in different tumors and frequently in different portions of one tumor. They undoubtedly arise from the ducts of the mammary gland, or from the embryonic epithelial elements from which the ducts are derived, but they do not appear to be continuous with the ducts which open at the nipple. In many cases the epithelial elements are few in number, and present the appearance of gland ducts of varying size, which have been distended and distorted by the growth into and around them of the periductal fibrous tissue. This produces the slit cysts so characteristic of these tumors, which have led to their being called "intracanalicular papillary fibroma." In other instances the epithelial elements are more numerous and appear to have kept pace with the growth of the fibrous tissue, so that in place of the distorted clefts a uniform tissue is produced, consisting of many small epithelial-lined tubules separated by a stroma of periductal fibrous tissue. In some cases a grape-like grouping of the smaller lobules can be

recognized. In others the orderly arrangement is lost, and the lobules lie helter-skelter in the fibrous stroma. The tumors of this latter variety have usually been classified as fibro-adenoma or adenofibroma, and Rodman has recently adopted the term "pericanalicular" to describe them, as opposed to the tumors with the slit cysts or clefts which he calls "intracanalicular." It seems to us best to retain them both under one heading, because, although the two extremes of type can be clearly recognized, there are many tumors which show the characteristics of both classes, and a distinction in every case is an impossibility. It is certain, however, that the "intracanalicular" type is the more common.

The epithelial cells of these different forms of gland ducts are of much variety. In the larger clefts and ducts compressed columnar cells, similar to those lining the larger milk ducts, are usually found. In the smaller lobules, cuboidal, more clearly defined, and larger cells are present. When cysts are formed all varieties of epithelium, from flattened to cuboidal and even high columnar cells, are sometimes present. From the characteristics of the epithelium we have at times supposed that in the tumors of the "intracanalicular" type the process originated in the larger ducts, whereas in the "pericanalicular" group it was the terminal portions of the gland ducts (acini) which were concerned. This supposition, however, is quite incapable of proof. Cysts occur in tumors of both groups, but in the pure pericanalicular tumors they are rarely of large size while in the other class they may obtain considerable dimensions.

The activity of growth of the ductal epithelium in these tumors seems to be of slight extent. Occasionally a mitotic figure is observed, but the impression is given that the epithelium has merely kept pace with the changes of size and shape of its basement membranes, produced by the new growth of the periductal tissue. It is true that a certain number of tumors, which probably originate in the periductal group, do show greater epithelial activity than has been described above, but these tumors will be discussed further on, under a separate class as "fibrocystadenomata."

The clinical characteristics of the periductal fibromata are fairly well defined. They are the common tumors of the breast in young women. In a table prepared for a paper by Dr. Warren it was found that they gave 45 per cent. and 50 per cent. of the tumors in the breasts of women from 10-20 and 20-30 years of age, while in later decades the proportion diminished very rapidly. Of the 27 cases in this series the oldest was 40, the youngest 15, and the average 28.8. The majority occur in unmarried women, and the tumor is independent in its origin of the stimulus of pregnancy or lactation. They are, as a rule, of slow growth and of long duration, the average in our series of cases being 22.1 months before operation. In some cases a sudden period of rapid growth may supervene after a long time of relative quiescence. In other cases an increase in size of the tumor has been distinctly noted during the menstrual period, and this is often accompanied by an increased sensitiveness, if not by actual pain. In only 9 of the 27 cases, however, was pain of any kind complained of, and then it was usually described as of but slight significance. In some patients, however, a tumor of this nature may be the cause of considerable suffering, not only from the sensitiveness of the tumor but also from the mental anxiety with accompanies it.

Discharge from the nipple is not produced by periductal tumors. In only one case of this series was a discharge of any sort discovered, and in that case, a woman who had borne two children, the discharge was milk.

The attempt was made to distinguish between the intracanalicular and pericanalicular types of periductal tumors in regard to their clinical symptoms, but without success. There were four tumors that fell in the pericanalicular group, and three showed the characteristics of both classes, while in the 20 others no marked involvement of the smaller terminal branches could be made out. The clinical appearance of the tumors of the pericanalicular type were not distinguishable from those of the other classes, and the distinction is not, we believe, one of any great significance, although the difference

in the histological picture of the two tumors is considerable.

The diagnosis of the periductal fibroma depends upon the following characteristics: It appears in young women, is of slow and almost painless growth. Multiple tumors are not uncommon. It is freely mobile in the breast tissue, has well-defined margins of rounded and lobular outline, and has a consistency which is hard, but often elastic. It is almost never adherent to the skin or to the chest wall, and of course does not cause enlargement of the axillary glands. No discharge from the nipple is produced.

The periductal myxomata and sarcomata are usually larger tumors, and readily undergo degenerative changes causing areas of softening. The skin over them is generally thinned and often stretched so tightly as to appear to be adherent.

The papillary cystadenomata are small tumors, centrally situated, cystic, and may frequently be recognized by the discharge of blood from the nipple. When this symptom is absent (as in about 50 per cent. of cases) the diagnosis from a periductal tumor may be difficult. The cystadenoma, however, occurs more frequently in older women.

The fibrocystadenomata do not differ materially in clinical signs or symptoms from the periductal tumors. In some cases the fibrocystic tumors are of long duration and of larger size, and the recognition of definite elastic or fluctuating cystic areas in the tumor may be suggestive, but, as a rule, the fibrocystadenomata are operated upon as periductal tumors, and recognized only on microscopic examination.

Chronic inflammatory processes in the breast, such as tuberculosis, syphilis, actinomycosis, chronic abscess, and diffuse galactophoritis after lactation, produce less well-defined tumors, are usually adherent to the surrounding tissues, and often show inflammatory changes, and even discharging sinuses. The axillary glands are also frequently involved to a greater or less extent.

Cystic disease of the breast occurs at about the time of the menopause, and produces an induration less well defined than the periductal tumors. Cysts deep in the gland, or sur-

rounded by dense fibrous tissue, may give to the examining fingers a sensation not unlike that of a small periductal tumor in a younger woman. The diffuse and often bilateral character of cystic disease and the greater sensitiveness it produces will usually serve for its recognition.

Carcinoma of the breast is distinguished from periductal fibroma by its characteristic symptoms of indefinite outline, early adherence and loss of mobility, and invasion of axillary nodes. Cancer is expected in older women, while the periductal tumor is usually one of earlier onset, although in one case of this series medullary cancer was present in one breast and a periductal tumor in the other at the same time.

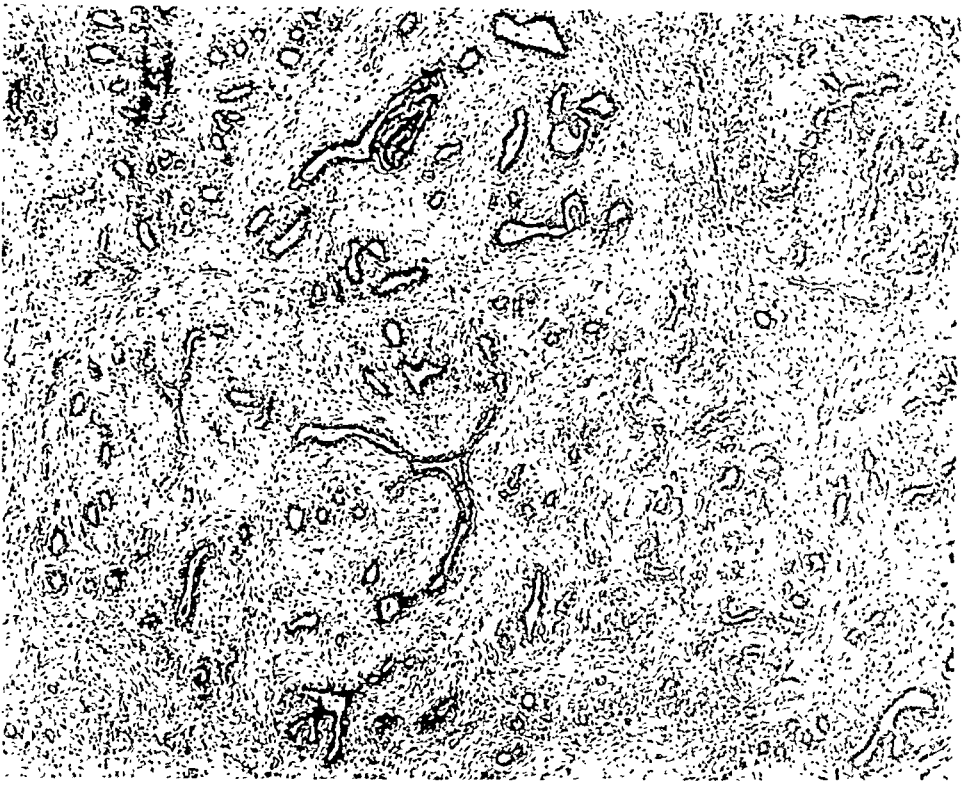
Sarcoma of the non-indigenous variety, though a rare tumor in the breast, is more likely to be confused with carcinoma than with other diseases. Its early infiltration and adherence and its rapid growth make the diagnosis of malignancy most probable.

Finally the tumors which are not peculiar to the breast, such as lipoma, enchondroma, angioma, etc., are to be differentiated by their characteristic symptoms, and occur so rarely in this situation as to merit little consideration in differential diagnosis. It is to be remembered, however, that few surgeons are sufficiently expert or sufficiently ready to accept the grave responsibility of depending upon the differential diagnosis of any tumor of the breast, from clinical appearances alone, to advise against operation. No tumor of the breast is innocent or incapable of harm to the patient until it has been removed. The differential diagnosis is of great importance in determining the appropriate treatment, and many a breast could be saved if the establishing of a diagnosis were more carefully attempted—not with the idea of avoiding operation, but with the intention of securing the operative treatment best suited to the individual case.

*Treatment.*—The treatment of periductal fibroma, like that of all other tumors of the breast, is by removal. In some cases of multiple tumors of small size in both breasts, writers

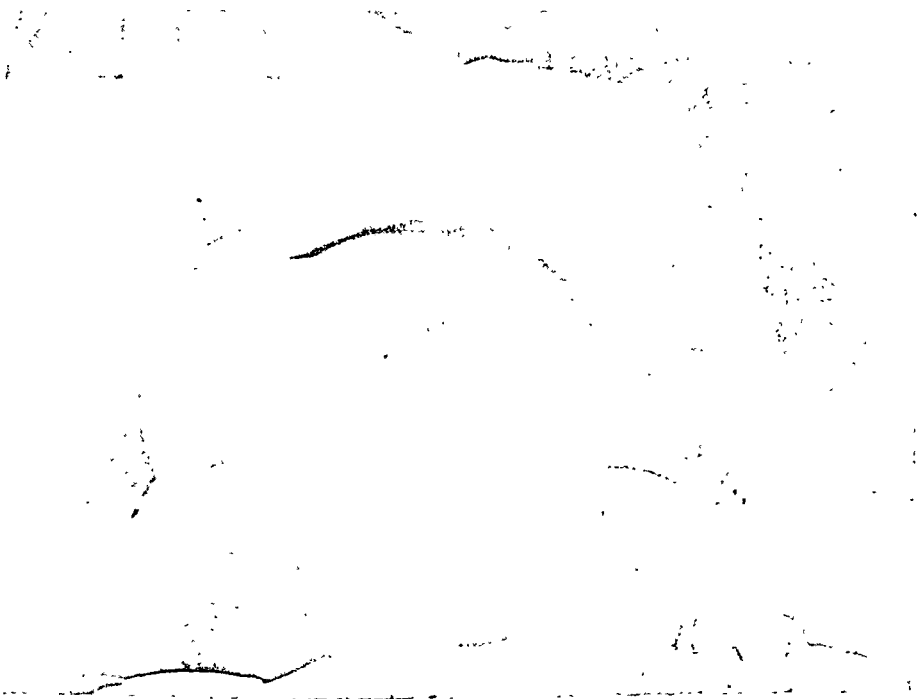


FIG. 4.



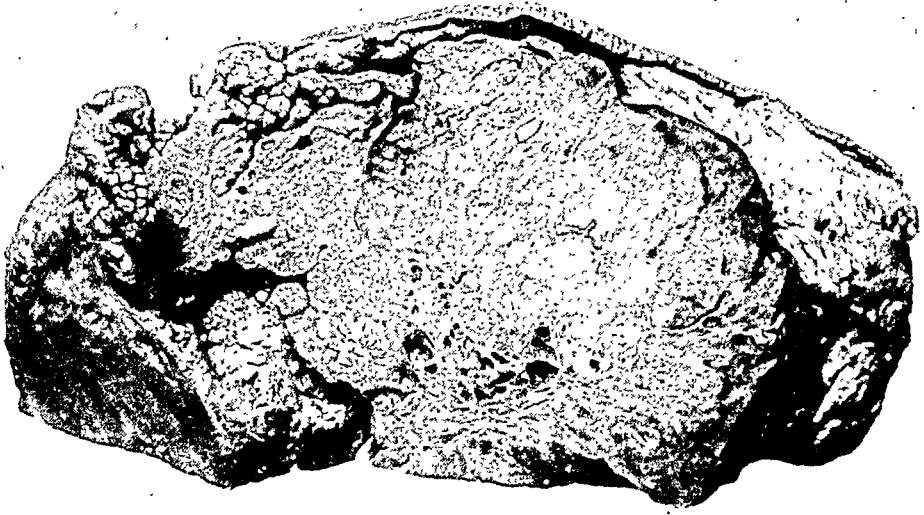
Periductal fibroma. Pericanalicular type. Low power, showing gland ducts only slightly distorted, but separated in stroma of periductal fibrous tissue. Compare with Fig. 2.

FIG. 5.



Periductal myxosarcoma. Clinical appearance.

FIG. 6.



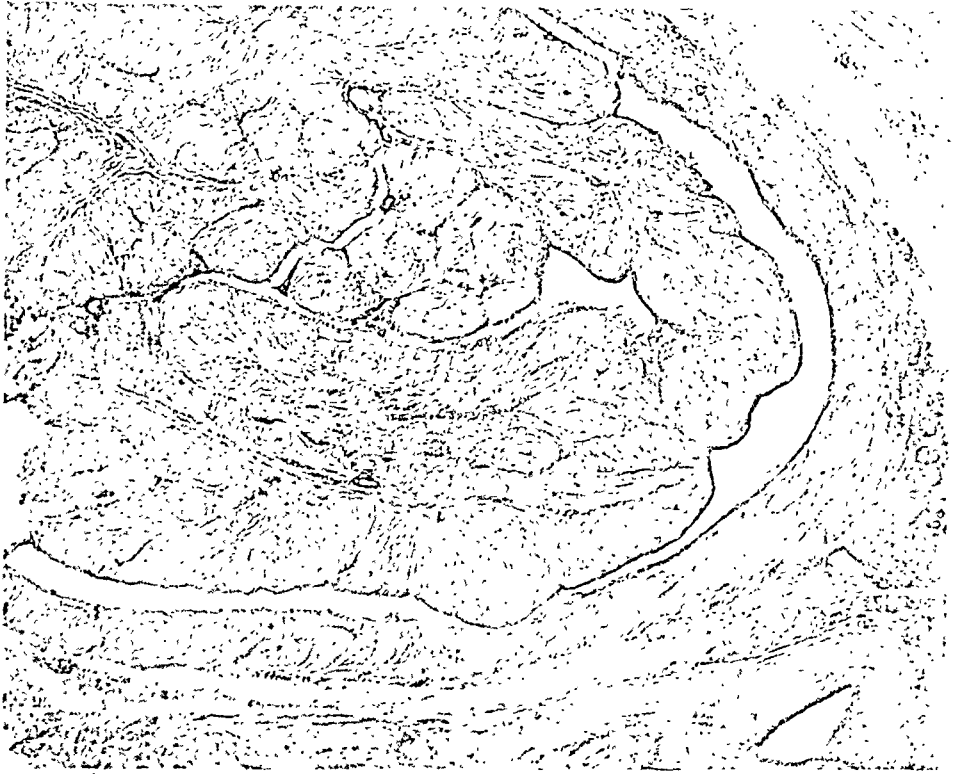
Periductal myxosarcoma. Gross appearances of preceding tumor. Note encapsulation, volume of tumor, cysts, and rounded, papillary intracystic projections.

FIG. 7.

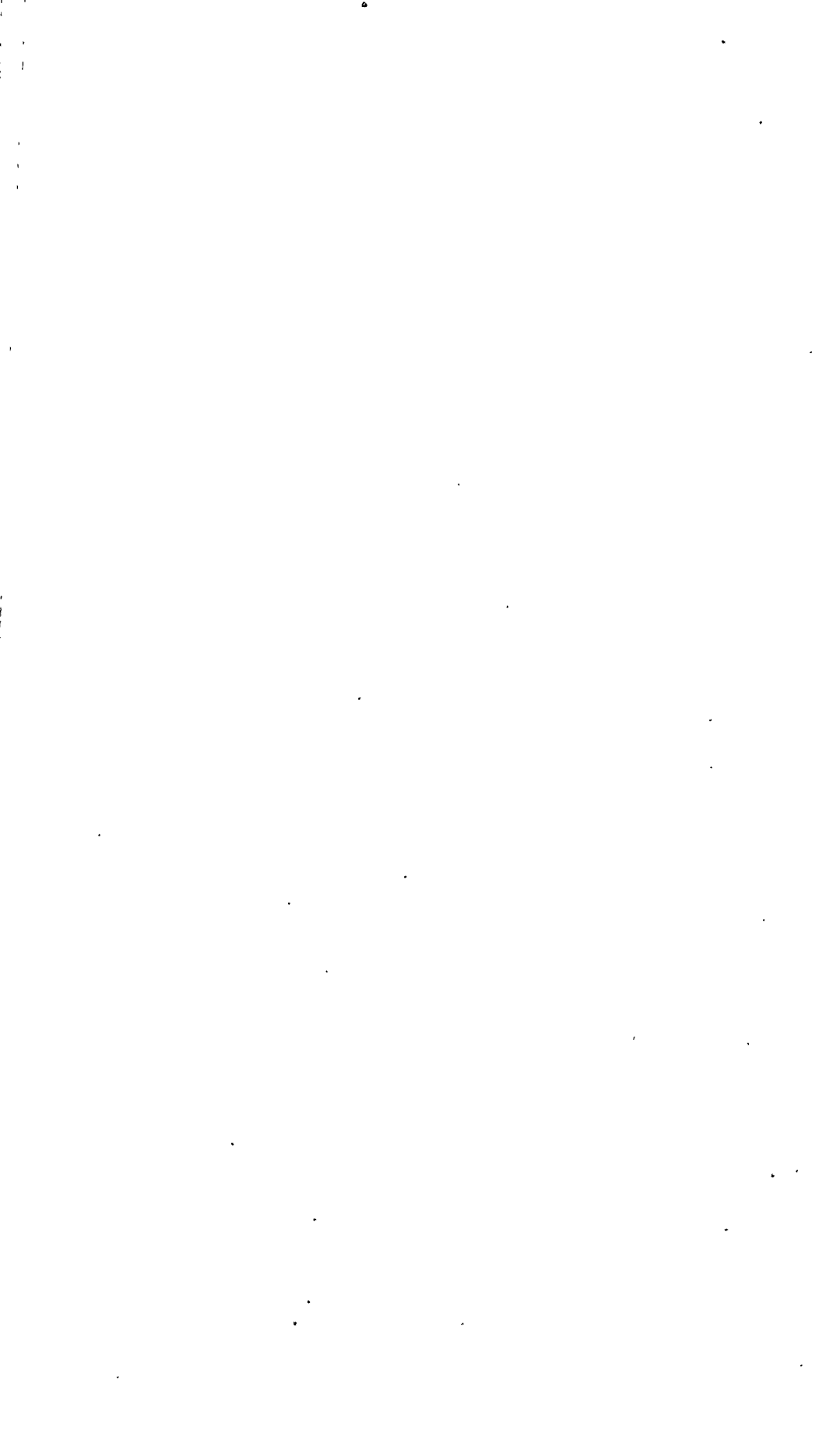


Periductal myxosarcoma. Low power. Portion of tumor showing cell-rich stroma of sarcomatous periductal tissue, gland ducts, and cysts and encapsulation.

FIG 8.



Periductal myxosarcoma. Low power. Portion of same microscopic section as Fig. 7; showing no evidence of sarcoma, but typical periductal fibroma. Other portions of this tumor showed typical myxomatous tissue in the stroma.



have advised against operation (Bloodgood), but so extreme a case has not come to our attention. 'Of this series of 27 cases, in 14 the tumor or tumors were excised through an incision directly over the tumor. In 11 cases a "plastic resection" was performed after the method advocated by Dr. Warren, the tumor being removed from underneath through an incision along the axillary and inferior margins of the breast. In 2 cases amputation was done: once under a mistaken diagnosis, and once because of the large size of the tumor. It is probable that with the exception of the very small and superficial tumors, the "plastic resection" is the operation of choice, as it places the scar in an inconspicuous position and does not add materially to the difficulties of operation: even the largest tumors may be removed by this method, and when the displaced breast tissue is drawn together a fairly respectable looking mamma will result.

#### PERIDUCTAL MYXOMA AND SARCOMA.

We have been able to collect six cases which can be placed in the myxosarcoma group. If an arbitrary division were attempted, four of these cases would be classed as periductal sarcoma, and two as periductal myxoma. We believe, however, that such a division is unnecessary and undesirable, and that the tumors of this character are best described under the one term "periductal myxosarcoma." They have heretofore been described in medical writings under a variety of different terms—cystic or cystosarcoma, adenosarcoma, fibromyxosarcoma, fibrosarcoma, cystosarcoma phyllodes, etc. The relation they have to the periductal fibromata and their differentiation from the simple or non-indigenous sarcomata, which occur but rarely in the female breast, have not always been clearly drawn. In a series of 658 consecutive cases of breast tumor taken from the records of the Massachusetts General Hospital,<sup>3</sup> there were 459 cases of carcinoma (69 per cent.); 14 of myxosarcoma (2 per cent.); 48 of periductal fibromata (7 per cent.) and 4 of non-indigenous sarcoma (0.6 per cent.). The peri-

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<sup>3</sup> Warren, J. C.: Jour. A. M. A., July 15, 1905.

ductal myxosarcoma, though a rare tumor, is the most common form of sarcoma of the breast.

The gross characteristics of the myxosarcoma in the six cases here collected were well defined. Single tumors were present in five cases, and a tumor was present in both the right and left breast in one case. The tumors were of relatively large size, the smallest being 5 cm. in diameter, and the others being estimated as of the size of an apple or orange up to that of a child's head. They practically occupied or displaced the whole breast, so that their situation in that organ could not be determined. The consistency of the tumors was usually described as hard, and the surface as irregularly lobulated; rarely cystic areas were recognizable, in one case a cyst the size of a grape-fruit being present.

Adherence of the skin over the tumor was noted in but two cases, and in one of these there was actual ulceration and an offensive discharge from the necrosing tumor tissue. In several cases, dilated veins over the tumor were recorded.

On section of the tumor, after removal, the usual description was that of a grayish, more or less translucent tissue, in lobular arrangement, with cyst or cleft formation. Complete or partial necrosis of the tissue was present in two cases. Cysts varied in size from microscopic dimensions to one the size of a grape-fruit, the contents being serous or brownish fluid. Papillary outgrowths into a cyst cavity were present in four of the six cases. In four of the six cases definite mention is made of a capsule delimiting the tumor from the breast tissue.

The microscopic sections of these tumors showed a characteristic though varied picture. The stroma of the tumor is composed of more or less cellular connective tissue, separated into lobules by strands of ordinary fibrous tissue. Through the stroma are scattered epithelial-lined ducts, cysts, or clefts. The connective tissue almost always varies in different portions of the specimen, and presents all gradations from the loose, fibrous tissue of the periductal fibroma, through the more cellular myxomatous tissue with stellate cells and delicate pro-

cesses, up to the richly cellular compact tissue of a fibrosarcoma. Tissues of these different cell characters not uncommonly lie side by side in the same preparation, and it is on this account that the differentiation of the periductal myxoma from the periductal sarcoma is so difficult and, we think, unnecessary. In the more cellular portions of the tumor mitotic figures may be seen. Necrosis and gelatinous or hyaline degeneration of the tissue were common in the larger tumors.

The epithelial structure consists of ducts, clefts, and cysts, lined with one or more layers of epithelium, exactly similar in every way to the epithelial elements of the periductal fibroma. In fact the resemblances of the two groups of tumors, not only from gross and microscopic appearances but from clinical symptoms as well, are such as to force upon the observer the conclusion that the myxosarcoma is a periductal fibroma, the fibrous tissue of which has more or less taken on the change in characteristics (anaplasia) which marks the advance from benign to malignant tumor growth—a change which, whether correctly or not, is often spoken of as “degeneration.”

The clinical symptoms of periductal myxosarcoma are fairly well defined. They occur at a period later in life than the periductal fibroma, the youngest of our six cases being 36, the oldest 53, and the average 49 years. Three were in single and 3 in married women, and lactation appeared to be in no way associated with the onset or progress of the tumor. In one case a blow received upon the breast was thought to have occasioned the appearance of the tumor which had not before that time been detected.

The rate of growth of the tumors is comparatively rapid: one tumor in eight weeks grew to be the size of an orange; and another after incomplete removal grew in five weeks to the size of a child's head. In a third case, a small tumor was present for 12 years, but began to grow rapidly five weeks before entrance, and attained a size of 10 x 20 cm. at operation. No retrogression in size was ever noted, and no discharge of fluid from the nipple. In one case the nipple was thought to have been retracted. No

pain was caused by these tumors, although the weight of the breast and, in one case, the ulceration caused discomfort. The axillary glands were not noted as enlarged except in one case, where a small, soft gland was felt and removed at operation but no evidence of sarcomatous involvement of it was recorded.

The diagnosis of periductal myxosarcoma should not be difficult. The tumors occur later in life, as a rule, than the fibroma, and are of larger size and more rapid growth. They are encapsulated and non-adherent unless necrosis of the tissue occurs or the skin is stretched and thinned over the tumor so as to favor ulceration. No carcinoma of the breast reaches such a size without its diagnosis being certain from the involvement of the skin and muscles and of the axillary glands.

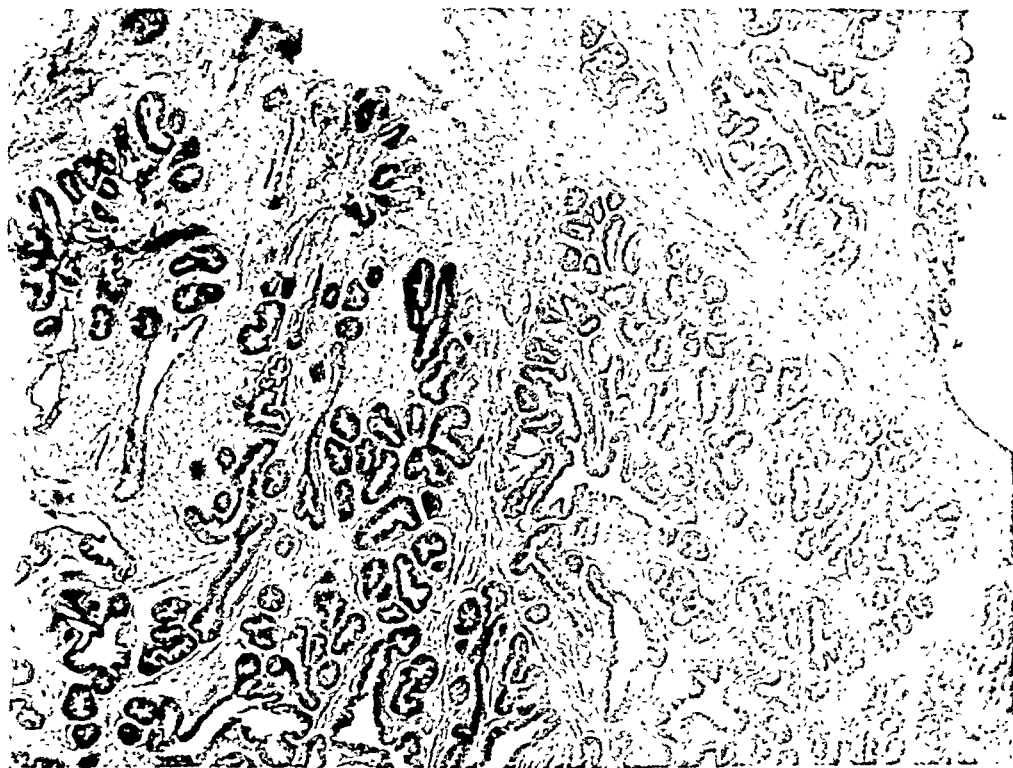
The treatment should be complete removal of the tumor by amputation of the breast. The axillary contents and the pectoral muscles, however, do not need to be removed. Of the six cases here reported five had amputation of the breast, and in one case an excision was done. The excision is free from recurrence  $7\frac{1}{2}$  years after operation. Of the five amputations 2 are dead, one of unknown cause nearly 2 years after operation, one of pneumonia 4 years after operation, when about to undergo operation for a tumor in the other breast, which was thought by her attendant to be a recurrence of the sarcoma although no local recurrence in the scar of the first operation had taken place. Two of the other amputations were well 8 years and 1 year respectively after operation, and of one case no data could be obtained. One of the cases in which amputation was successfully performed had had a tumor the size of a hen's egg (a myxofibroma) excised 3 years before. Thus excision of the tumor without amputation must be considered hazardous, but a complete amputation should be expected to result in permanent relief.

#### FIBROCYSTADENOMA.

The tumors of this group are what might be termed the epithelial type of the periductal fibromata, and differ from them

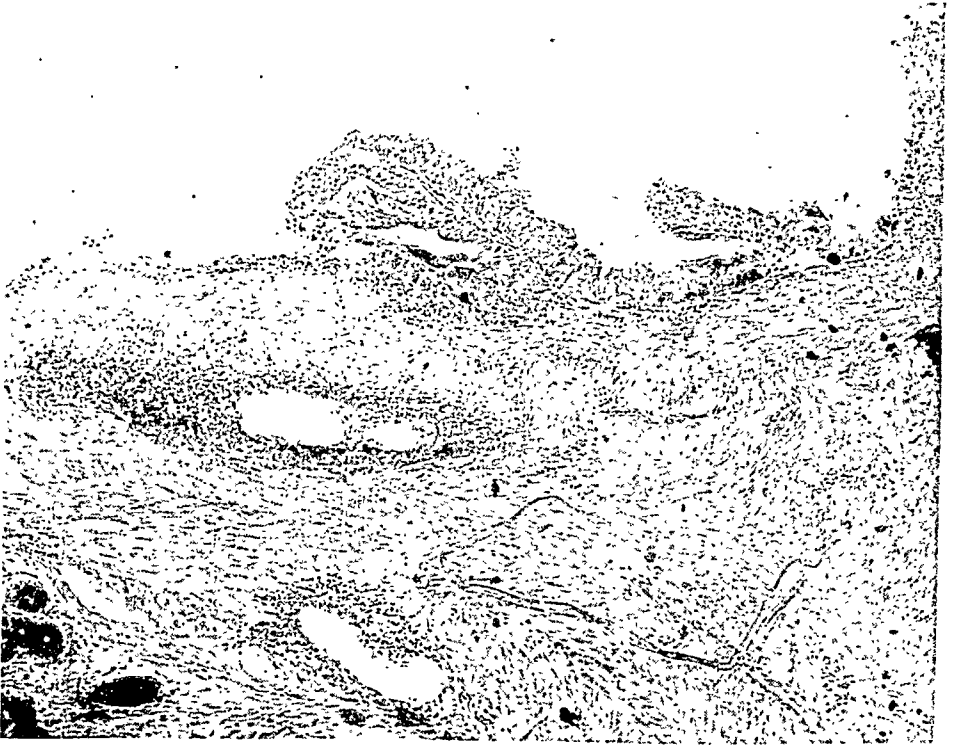


FIG. 9.



Fibrocystadenoma. Low power, showing large number of gland ducts and cysts, extension of epithelium into stroma, and active proliferation of epithelium.

FIG. 10.



Fibrocystadenoma. Low power, showing proliferation of epithelium on papillary projections into a cyst.

only in the relation of the component parts. In the periductal fibromata the epithelial structures of the glands and ducts appear to be passively distorted by the growth of the periductal tissue. The fibrocystadenomata, on the other hand, although showing a growth of periductal tissue, have as their main characteristic a marked hyperplasia of the epithelial elements. A hard and fast line between the two tumors cannot always be drawn, because the diagnosis depends on the impression of the relative activity of the growth of the two component tissues. In fact, it is doubtful whether any special importance would attach to the making of this distinction if it were not for the fact that, because of the predisposition of the breast to cancer, active proliferation of the adult gland epithelium from any other cause than pregnancy and lactation is to be regarded with suspicion.

In the fibrocystadenoma group of the fibroepithelial tumors there were ten cases, in two of which both breasts were affected. In the hospital records these cases had been variously classified and many different pathological names had been applied to them, but in comparing them they all seemed to belong in the same group. Five were diagnosed as fibrocystadenoma. To one the term adenoma had been applied, two were diagnosed as periductal fibroma, one as adenofibroma, and one as intracanalicular papillary myxofibroma.

In gross, the tumors all appeared firm, elastic, well-encapsulated growths, varying in size from 2 cm. to 7 cm. in diameter. They were for the most part roughly round in shape, but the two largest, both over 6 cm. in diameter, were lobulated. In consistency they were described clinically as "hard" six times and twice as "firm," while in the pathological reports they were variously designated as firm, elastic, or fibrous.

On section the tumors had the general appearance of the periductal fibromata. The tissue was firm, fibrous, and usually of a dull white color, although in some cases it was somewhat translucent—this probably being due for the most part to œdema. On the cut surface numerous soft, glistening points

representing the ducts and acini could be seen, these being relatively more numerous than in the periductal fibromata. In but one case did the growth in gross show marked slits, then it was intracanalicular in type. In the three largest tumors there were many small cysts, these varying in size up to 1.5 cm in diameter. In two of these the cysts were filled with clear, straw-colored fluid, while in the third the contents were described as pultaceous.

The chief and characteristic difference of these tumors from the periductal fibromata is the proportionately large amount of epithelium in relation to the fibrous tissue. The epithelium is the tissue which appears to show the most active growth. The tumors have a distinct, dense, fibrous capsule. Within this there is a tendency to a lobular arrangement of the tumor tissue, which is less marked or may be absent in the smaller growths. The stroma is as that of the periductal fibroma—loose, cellular, fibrous tissue without round-cell infiltration, evidently derived from the connective tissue immediately around the ducts. Two chief types of the growth may be distinguished as in the periductal group, *i.e.*, the pericanalicular and the intracanalicular types; of these the former is the more common, and although the two types merge somewhat, one into the other, the suggestion is strong that the periductal fibromata of the pericanalicular type are those from which the fibrocystadenoma is chiefly derived. Cysts lined with one or more layers of epithelium are present more frequently than in the fibroma group, and the ducts themselves have a great variety in appearance. In some cases the glands and ducts seem comparatively normal, but are increased in numbers beyond the conditions found in the normal non-lactating breast tissue. In other cases they are much distorted, while in still other instances the cells lining them show all the characteristic proliferative changes seen in cases of abnormal involution or cystic disease of the breast. Thus, while many glands are lined with a single layer of cuboidal or columnar epithelium, others show a heaping up of the cells forming papillary growths projecting into the lumen, and this process may be

so pronounced that the lumen is entirely plugged. The cells may even have an adenomatous arrangement, which is what might be termed the most extreme type of epithelial proliferation, and is similar to that seen in the abnormal involution cases which have a tendency to progress to carcinoma.

The patients varied in age from 15 to 44, the average of the ten being 30.5 years. Five were married and five single, but the records were too imperfect to allow any conclusions to be drawn as to the relation of lactation to the tumors. The length of time elapsing between the discovery of the growth and the seeking of medical advice varied from three months to five years, but the duration bore no relation to the size of the tumor. Thus one tumor of the size of an orange was of only three months' duration, while a tumor the size of a pigeon's egg had been present five years. No mention was made of the tumors varying in size, with the exception of one case in which fluctuation in size was quite marked, but had no relation to menstruation. In this case the change in size was probably dependent on the filling and emptying of cysts which were present in large numbers. In no case was a discharge from the nipple noted.

Five patients complained of pain, and in three cases the pain was neuralgic in character, shooting down the arm (mastodynia). In the other two it was spoken of as "slight." It had no relation to the catamenia. The right breast was the seat of the tumor five times, the left three, while in two cases both breasts were involved. In only one of these two, however, were both breasts operated upon, and in this case, while one of the tumors was a typical fibrocystadenoma, the other could best be classified in the periductal group. The tumors occupied any position in the breast, and varied in size up to that of an orange. They were freely movable over the deeper parts, and not adherent to the skin even when of large size. In but two cases was the presence of enlarged axillary glands noted.

It is practically impossible to differentiate between the periductal fibromata and the fibrocystadenomata clinically. The

average age of the patient, the rapidity of the growth, and the portion of the breast involved are the same. Neither is adherent, nor are enlarged glands usually present in the axilla. In a few of the larger tumors it may be possible to palpate the cysts if any are present, and thus establish the diagnosis, but true fluctuation in small breast cysts is extremely difficult to determine. For the differentiation of the fibrocystadenomata from the tumors of the breast other than the periductal fibroma, the reader is referred to the differential diagnosis of the fibromata given above. The treatment also is that of the periductal fibroma, that is, excision of the tumor, performed when possible by the "plastic resection" method. The prognosis is, of course, favorable, and no recurrence will take place after thorough removal.

#### SUMMARY.

A comparative study of the fibro-epithelial tumors of the breast shows that their relations one to another are very close, and justifies their being grouped together as in the Warren classification. The essential feature of the tumors of the fibrous type is the presence of periductal fibrous tissue in more or less abundance about the gland ducts. This periductal tissue may vary in cell richness from normal fibrous tissue to myxomatous or sarcomatous tissue. The two types of tumor, however, with this exception are so much alike that the sarcoma type may be well considered merely a modification of the benign fibroma. The periductal fibroma needs only excision of the tumor to effect a cure. For the periductal myxosarcoma, amputation of the breast is advised, without removal of the muscles or dissection of the axilla; the tumor is only locally malignant.

The fibrocystadenoma group includes a few tumors of similar origin to the foregoing, which display, when examined by the microscope, a tendency to epithelial overgrowth. The diagnosis between fibrocystadenoma and periductal fibroma cannot be made with certainty before the removal of the tumor. This tendency to epithelial proliferation is encoun-

tered in other diseases of the breast, such as abnormal involution of cystic disease; and is an undoubted source of danger to the patient in adult life. For this reason, complete removal of any fibro-epithelial tumor of the breast by early operation is the best treatment to be advised.

## ABSTRACT OF CASES.

*Periductal Fibroma.*

*Case G.* (562-241.) Dr. C. L. Scudder.—21, single. History deficient. Small fibrous tumor of breast removed at operation for appendicitis. *Mx.* irregularly dilated ducts, flattened epithelium, slit cysts. Periductal fibroma.

*Case H.* (CXLII., 49.) Dr. F. G. Balch.—25, single. 7 years' duration. Pain, especially at cta. Size marble, lower outer quadrant right breast. Non-adherent, excised. Two small nodules, myxomatous (œdematous) fibrous tissue with cavities. Intracanalicular type. Periductal fibroma.

*Case F.* (526-221.) Dr. R. B. Greenough.—23, married, children, long duration, no pain. Entrance diagnosis, fibroma. Two tumors outer hemisphere left breast, size of orange and chestnut. Hard, not tender, non-adherent. Plastic resection. Two lobulated nodules, few cysts, pericanalicular type. Some epithelial proliferation. Periductal fibroma.

*Case D.* (516-21.) Dr. R. B. Greenough.—31, widow. 4 weeks' duration, no pain. Patient had left breast amputated for carcinoma 6 months previous. Nodule size of chestnut, outer hemisphere right breast. Hard, non-adherent, not tender. Excised. Tumor 8 x 3 cm., encapsulated, myxomatous with clefts. Intracanalicular type. Clefts lined with single layer epithelium. Œdematous fibrous tissue. Periductal fibroma.

*Case 161.* (XLVII-124.) Dr. W. M. Conant.—26, single, six months', no pain. Tumor size of large bean, right breast, upper inner quadrant, not tender, non-adherent. Similar tumor removed from right breast three years before. Excision. Fibrous tumor, white, hard. *Mx.* shows few ducts and cysts. Intracanalicular type. Papillary fibroma.

*Case 42.* (398-138.) Dr. J. C. Warren.—35, single, six months, slow growth, no pain, left breast, size of walnut, upper outer quadrant, not tender or adherent. Excised. Encapsulated tumor, gray, with slit cysts. Intracanalicular type, œdematous fibrous tissue. Periductal fibroma.

*Case 113.* (449-55.) Dr. S. J. Mixer.—27, single, 10 years, slow growth, tumors both breasts, size of small egg and smaller, hard, non-adherent. Excised. Tumors firm, white, with slit cysts. Intracanalicular type. Periductal fibroma.

*Case 185.* (LXXXIII-211.) Dr. H. H. A. Beach.—19, single, 1 year, slow, fluctuation in size, slight pain. Tumor size of hen's egg, right breast, hard, non-adherent, not tender. Excised. Encapsulated lobulated tumor, fibrous, with slit cysts. Intracanalicular type. Slight epithelial activity. Periductal fibroma.

*Case P.* (537-379.) Dr. J. G. Mumford.—38, married, three children,

eight months, slow growth, slight pain. Tumor size orange, centre, right breast. Slightly tender, non-adherent. Amputation. Encapsulated tumor, translucent, gray, slit cysts, oedematous fibrous tissue, few small cysts. Periductal fibroma.

*Case 200.* (480-107.) Dr. C. L. Scudder.—37, married, two children, five months, no pain. Tumor size of orange, centre right breast, hard, nipple exudes milk, both sides, non-adherent. Amputation. Encapsulated tumor, firm, translucent, gray, slit cysts. Intracanalicular type. Periductal fibroma.

*Case 180.* (LXXV-243.) Dr. A. T. Cabot.—36, single, ten months, no pain, tumor size of horse chestnut. Lower hemisphere left breast. Hard, non-adherent. Excised. Encapsulated tumor, fibrous, with slit cysts. Intracanalicular type. Periductal fibroma.

*Case 112.* (423-93.) Dr. H. H. A. Beach.—27, single, 1½ years, slow growth, no pain. Right breast, inner hemisphere. Tumor 2 inches in diameter. Soft, non-adherent. Amputation. Fibrous tumor with irregularly dilated ducts and slit cysts. Intracanalicular type. Periductal fibroma.

*Case 93.* (375-186.) Dr. M. H. Richardson.—38, married, three months, slight pain, left breast, upper outer quadrant, size of walnut, hard, slightly tender, non-adherent. Excised. Several fibrous nodules in breast showing increase of fibrous tissue and proliferation of gland ducts. Pericanalicular type. Periductal fibroma.

*Case 34.* (388-54.) Dr. J. W. Elliot.—29, married, seven children, seven years' duration, slow growth, slight pain, two tumors size of walnut upper hemisphere right breast, hard, non-adherent. Resection. Three discrete fibrous tumors in substance of gland. Intracanalicular and pericanalicular in different areas. No epithelial proliferation. Periductal fibroma.

*Case 196.* (CIII-99.) Dr. W. M. Conant.—52, married, two children, one year's duration. Slow growth, no pain. Tumor 3 x 5 cm. upper outer quadrant left breast, hard, non-adherent. Partial excision. Tumor encapsulated, marked papillary construction. Intracanalicular type, slit cysts. Periductal fibroma.

*Case 214.* (LXIX-153.) Dr. C. B. Porter.—17, single, six months, slow growth, no pain. Tumor size of walnut, lower outer quadrant right breast. Hard, non-adherent. Excised. 2 cm. Tumor white, fibrous, slit cysts. Intracanalicular type. Periductal fibroma.

*Case 212.* (140-504.) Dr. J. C. Warren.—40, married, four children, 1 year, pain. Tumor size of pigeon's egg, right breast, upper outer quadrant. Hard, tender, non-adherent. Excision. Two tumors, encapsulated, gray, firm, slit cysts. Intracanalicular type. Periductal fibroma.

*Case 208.* (492-151.) Dr. J. C. Warren.—35, single, one year, slow growth, no pain. Tumor size of walnut, inner hemisphere right breast. Not tender or adherent. Excision. Encapsulated nodule, slit cysts. Intracanalicular type. Periductal fibroma.

*Case 210.* (492-269.) Dr. J. C. Warren.—32, single, three months' duration, no pain. Tumor size of hen's egg, upper inner quadrant right breast. Not tender or adherent. Excision. Firm fibrous tumor, slit



cysts. Intracanalicular type. Slight activity of epithelium. Periductal fibroma.

*Case E.* (CXXI-27.) Dr. H. H. Beach.—27, single, two years, no pain, left breast, outer hemisphere. Tumor size of egg, hard, slightly adherent (?). Excised. Flat oval tumor, lobulated, fibrous consistency. Pericanalicular type. Myxomatous connective tissue, no cysts. Periductal fibroma.

*Case I.* (570-83.) Dr. L. Davis.—15, single, 1 year, pain slight, tumors in both breasts, hard, 1 and 2 inches in diameter, non-adherent. Excised. Fibrous tumors with slit cysts. Intracanalicular type. Periductal fibroma.

*Case M.* (530-213.) Dr. M. H. Richardson.—33, married, 1 child, 3-4 years, no pain. Tumor size of orange, upper inner quadrant left breast. Hard, non-adherent. Excision. Two encapsulated tumors, gray, fibrous, slit cysts. Intracanalicular type. Periductal fibroma.

*Case T.* O. P. D. (133-190.) Dr. L. Davis.—19, single, two months, tumor size of walnut, upper inner quadrant left breast, non-adherent. Excision. Fibrous encapsulated tumor, 2 x 3 cm., lobulated. Intracanalicular type.

*Case B.* O. P. D. Dr. C. C. Simmons.—26, single, 1 year's duration, no pain, size of hen's egg, lower outer quadrant right breast, hard, non-adherent. Excision. Encapsulated tumor, fibrous, lobulated. Intracanalicular type, few cysts. Periductal fibroma.

*Case Q.* (596-133.) Dr. F. B. Harrington.—27, married, 1 year's duration, slow, slight pain. Tumor size of walnut, lower outer quadrant left breast, hard, non-adherent. Excision. Tumor encapsulated, 2 cm., nodular, myxomatous connecting tissue. Pericanalicular type. Periductal fibroma.

*Case R.* (CLVIII-129.) Dr. J. G. Mumford.—25, single, two years' duration, no pain. Tumor 1 inch in diameter, inner hemisphere left breast. Hard, lobulated, non-adherent. Excision. Encapsulated, lobulated growth, white, firm. Intracanalicular type, few small cysts. Periductal fibroma.

*Case C.* (503-251.) June, 1905. Dr. H. Williams.—17, single, eight weeks, some diffuse pain. Tumor size 3 inches, left breast, outer hemisphere, nodular, non-adherent. Excision. Encapsulated tumor, gray, white, slit cysts. Very cellular fibrous tissue. Intracanalicular type.

#### *Periductal Myxosarcoma.*

*Case K.* (561-121.) Dr. S. J. Mixer.—52, single, seven months' duration, following a blow, no pain. Tumor size of apple in central portion of left breast, hard, skin slightly adherent, veins dilated, no axillary glands. Amputation. Encapsulated, semi-necrotic, grayish tumor. Mx. shows spaces surrounded by cellular myxomatous tissue, epithelium of ducts degenerated. Periductal myxo-sarcoma. No recurrence one year later.

*Case 94.* (381-208.) Dr. S. J. Mixer.—49, married, three months' duration, no pain. Tumor size of walnut lower outer quadrant right breast, non-adherent, no glands. Excision. Lobular tumor, gray, translucent.

Minute cysts. Mx. shows cellular stroma with scattered epithelial tubules. Adeno-sarcoma. No recurrence eight years later.

*Case 172.* (LXVII.) Oct. 28, 1902. Dr. C. B. Porter.—53, single, twelve years' duration, rapid growth, 5 mos., no pain. Tumor size child's head, occupying left breast, non-adherent, no glands. Amputation. Encapsulated tumor, gray, gelatinous, with clefts. Mx. shows cellular myxomatous and sarcomatous tissue interspersed with gland ducts. Intracanalicular type. Periductal sarcoma. No recurrence one year later, died three years later of pneumonia. ? of tumor in other breast.

*Case 178.* (LXXIII-65.) Dr. A. T. Cabot.—51, married, 4 years' duration, slow growth, slight discomfort. Tumor 23 cm. in diameter, occupying left breast, ulcerated and skin adherent, dilated veins, no axillary glands. Amputation. Large tumor, gelatinous, lobulated, slit cysts. One large size cyst size of egg with papillary outgrowths, cellular fibrous and myxomatous tissue. Periductal myxoma-sarcoma. Patient died two years later, cause unknown.

*Case 216* (XXXIII-45.) Dr. J. W. Elliot.—40, married, 1 child, tumor 8 weeks' duration, rapid growth. Tumor size orange, middle right breast, hard, non-adherent, one small axillary gland. Amputation with dissection of axilla. Encapsulated tumor 5 cm. in diameter, lobular, grayish, translucent. Mx., myxomatous tissue and gland ducts with some proliferation of epithelium. Periductal myxo-sarcoma.

*Case 159.* (XLVII-74.) Dr. W. M. Conant.—36, single, 4¼ years' duration. Tumor left breast, size hen's egg. 3½ years ago tumor in right breast size child's head. Operation three years ago. Amputation of right breast. Excision of left. Diagnosis: myxo-fibroma. Five weeks ago tumor developed in left breast, rapid growth, now size child's head, skin not adherent but discolored. Amputation. Encapsulated tumor with gelatinous tissue and cysts with brownish fluid and papillary projections. Periductal myxo-sarcoma. No recurrence 8 years later.

#### *Fibrocystadenoma.*

*Case 50.* (452-153.) Dr. C. L. Scudder.—38, married, 5 months' duration, slow growth, some pain. Tumor size of orange, inner lower quadrant right breast, hard. Excision. Encapsulated fibrous tumor, pearly-colored tissue, slit cysts. Mx. shows loose fibrous tissue, œdema (?), with active epithelial proliferation in cysts. Fibrocystadenoma.

*Case 179.* (LXXIII-187.) Dr. A. T. Cabot.—25, married, 4 years' duration, no pain, 4 tumors in right breast each about size of walnut, one tumor in centre left breast size lemon, non-adherent. Tumor on left excised. Fibrous tumor 4½ cm. with small cysts. Mx. shows much proliferation of epithelium. Fibrocystadenoma.

*Case L.* (523-85.) Dr. M. H. Richardson.—29, widow, 1 year, little pain, upper outer quadrant right breast, tumor size of orange, firm. Excision. Encapsulated tumor, œdematous, firm, with many cysts, loose fibrous tissue with active proliferation of glandular epithelium. Fibrocystadenoma.

*Case N.* (CXXVI-273.) Dr. F. G. Balch.—42, widow, 2 years' duration. Tumor size pigeon's egg upper outer quadrant right breast, non-adherent. Excised. Fibrous tumor 4 cm. in diameter, œdematous fibrous tissue, proliferation of epithelium in ducts. Small cysts. Pericanalicular type. Fibrocystadenoma.

*Case 213.* Dr. Torrey, June 28, 1902.—16, single, 8 months. Tumors in both breasts, one 2½ the other 3 cm. in diameter, hard, non-adherent. Excision. Both encapsulated tumors, white fibrous tissue and cysts. Active proliferation of epithelium, papillary projections. Fibrocystadenoma.

*Case A.* O. P. D. April 18, 1908. Dr. C. C. Simmons.—19, single, 5 years. Tumor size pigeon's egg upper hemisphere right breast, hard, non-adherent. Excision. Nodular, encapsulated tumor. Fibrous tissue, active proliferation of epithelium in cysts and ducts. Fibrocystadenoma.

*Case S.* (CLVII-129.) Dr. R. B. Greenough.—18, single, 1 year's duration. Slight pain. Tumor size egg lower hemisphere right breast, firm, non-adherent. Excision. Lobulated fibrous tumor. Active proliferation of duct epithelium and of periductal fibrous tissue. Pericanalicular type. Fibrocystadenoma.

*Case O.* (546-33.) Dr. C. L. Scudder.—44, single, 2 years' duration. Tumor size of horse chestnut, lower inner quadrant left breast, hard, non-adherent. Excision. Encapsulated tumor, hard, lobulated, gelatinous appearance. Myxœdematous fibrous type, with dilated and distorted ducts and active epithelial proliferation. Small cysts. Pericanalicular type. Fibrocystadenoma.

*Case 104.* (397-145.) Dr. M. H. Richardson.—36, single, 2 years' duration. No pain. Upper outer quadrant left breast. Tumor size of silver dollar, hard, non-adherent. Excision. Lobular tumor, circumscribed. Large epithelial ducts. Active proliferation.

*Case X.* Dr. H. Cabot, December 16, 1906.—38, married, 2 years' duration. Considerable pain. Tumor central in right breast, size of orange, hard, non-adherent. Excision. Lobulated tumor, encapsulated, circumscribed tissue. Small cysts. Ducts with epithelial proliferation. Fibrocystadenoma.

enemata, but, owing to the unreliability of the patient, it was impossible to obtain exposures at suitable times. In spite of these unavoidable gaps in the X-ray examination, some of the plates are of interest. Fig. 4 shows the hernia protruded. The difference in density between hernia and lung is very apparent. Fig. 5 shows two fingers inserted as deeply as possible through the defect in the thoracic wall between the eighth and ninth ribs.

The plates were made in the Gibbs Memorial X-ray Laboratory of the University and Bellevue Hospital Medical School, by the director, Dr. L. T. Le Wald, for whose valuable co-operation in the study of this case, I wish to express my gratitude and appreciation.

The patient does not desire an operation, stating that the hernia has never bothered him and that he does not believe it has grown any larger since its first appearance.

In view of his careless habits, I have not advised the wearing of any type of belt or supporter, believing that with his mode of life such an appliance might readily lead to strangulation.

In searching the literature, I found an excellent résumé of the subject by Alquier,<sup>2</sup> who collected nine cases. An abstract of these follows.

I. CLOQUET, *Nouveau Journal de Médecine*, December, 1819. A soldier, 35 years old, was run over by a piece of artillery at the battle of Lützen. The wheel passed over his lower thorax and upper abdomen. He was sick and miserable for seven years; finally, in 1815, came under the observation of Cloquet.

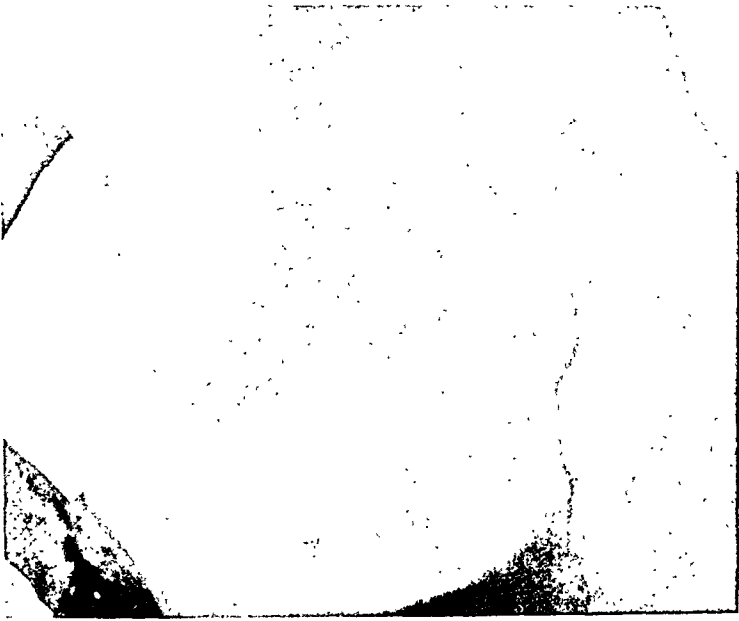
A tumor, the size of a nut at first, which had later enlarged to the size of an egg, lay in the space between the left eighth and ninth ribs at their junction with the costal cartilages. It was irreducible and painful. Any bodily activities resulted in an enlargement of the tumor, and these, or any attempts at reduction, caused nausea, vomiting, and intense colicky pains. The man led a miserable existence. What became of him was not recorded.

II. CRUVEILHIER in his *Anat. Path. Générale*, liv. xxi, Pt. iii, describes a "hernie intercostale traumatique abdominale" in a soldier, 70 years old, who had received a blow from a wagon tongue upon the left side of the thorax some years previously. A swelling, the size of a fist,

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<sup>2</sup> Paul Alquier: "La Hernie Intercostale Abdominale," Thèse de Paris, 1905-6.

FIG. 1.



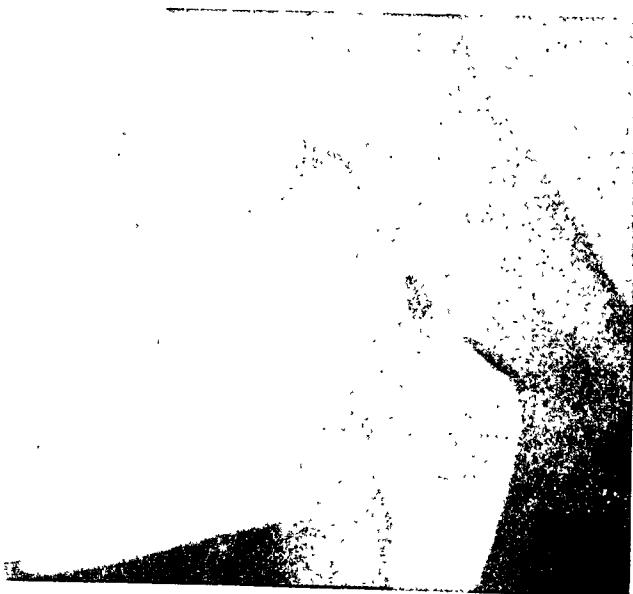
Shows the usual size of the hernia.

FIG. 2.

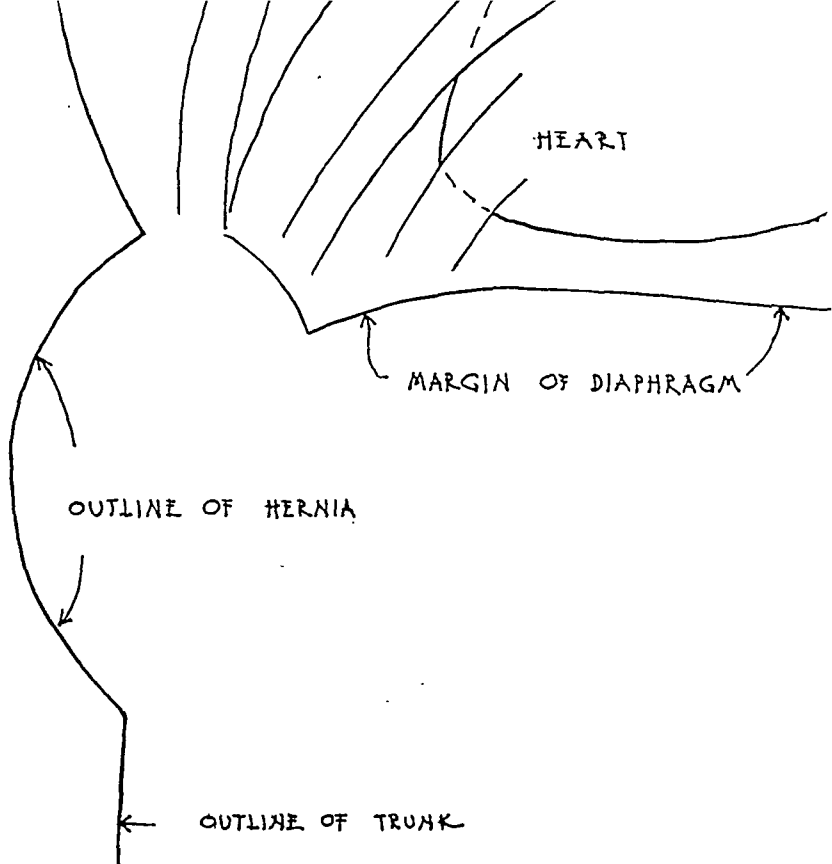


Shows the hernia at its maximal protrusion.

FIG. 3.

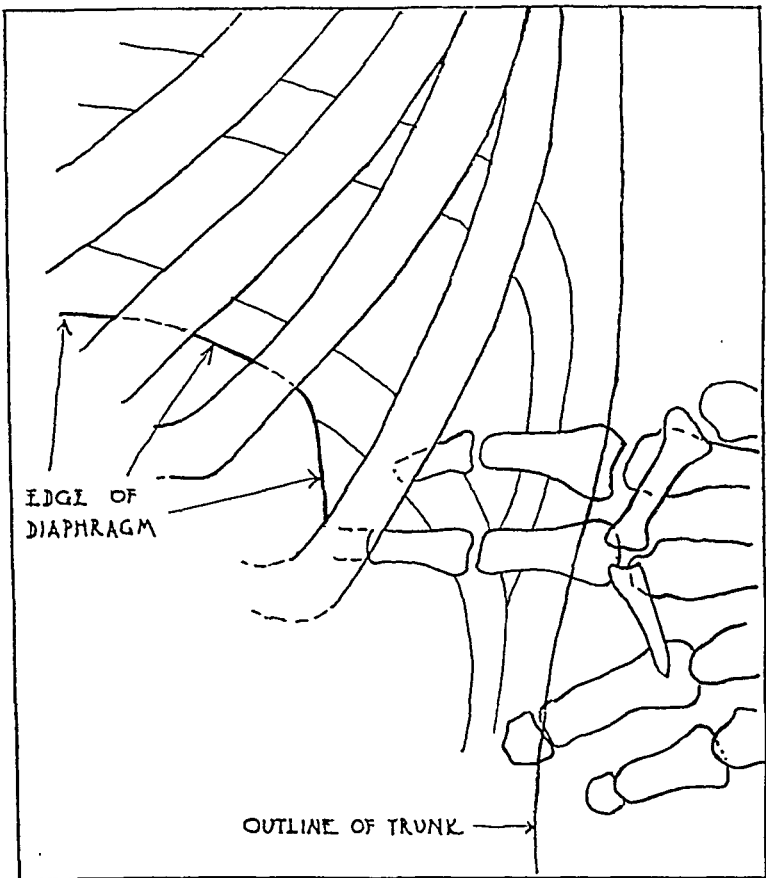


The free border of the ribs and the opening between the eighth and ninth ribs are indicated by pencil marks on the skin.



Skiagraph of tumor site viewed transversely.

FIG. 5.



Skiagraph of tumor site viewed anteroposteriorly.



lobulated, with a sessile base, irreducible but varying in size, was noted at the site of injury upon the left thorax, close to the costal margin. The man died of cirrhosis of the liver in 1828.

At autopsy the lobulated tumor was shown to have a fibrous pedicle, located in the space between the left eighth and ninth ribs. The sac was found to contain omentum adherent to all its recesses, which were represented externally by the lobulations. The intercostal diaphragmatic opening easily admitted the index finger. Close to this opening were stomach and splenic flexure, evidently ready to enter.

III. RISEL in the *Deutsche Zeitschrift f. Chir.*, Dec., 1875, Bd. vi, Hft. 3, p. 305, reports the case of a patient, 35 years old, who, in a fit of despondency seven months previously, had attempted suicide by repeatedly stabbing himself with a small blunt knife. The wounds healed, but later herniæ developed in the scars. One in the seventh left interspace, evidently contained omentum and gut, while one in the sixth interspace, was thought to contain stomach. An attack of bronchitis had caused rapid enlargement of the herniæ. No operation was done.

IV. BAZY's case was published by Iselin in *Gazette hebdomadaire de Med. et Chir.*, 1898.

A journalist, 26 years old, had been caught between two colliding wagons on Oct. 1, 1897. He sustained a contusion of the lower thorax and upper abdomen. An extensive ecchymosis immediately developed. Fifteen minutes after the accident a tumor appeared, which increased in size upon making the slightest effort. Hæmaturia lasted for some time, but finally ceased. He wore a belt on account of the tumor, but, because the apparatus became bothersome, he entered the hospital of St. Louis on March 12, 1898.

Examination showed a scar at the level of tenth rib. The tumor on coughing enlarged to the size of an ostrich egg. It was painless, tympanic, and totally reducible. Upon reduction, the opening was found in the tenth space, extending from its anterior end, back to the mid-axillary line. By introducing the hand through this hole, the under surface of the diaphragm could be palpated.

The operation by Bazy was done on March 17, 1898. A 15 cm. incision was made corresponding to the long axis of the tumor. Beneath the skin lay a fibrous sac. On dissecting through this, the colon was accidentally opened. The opening was closed by suture. Careful dissection was then continued close to, and denuding the tenth and eleventh ribs until the peritoneal cavity was finally opened (the hernia evidently was then reduced), and the opening closed by a catgut suture. The tenth interspace was then obliterated by approximating the adjacent ribs by means of two catgut sutures passed through the ninth and eleventh spaces. Layer suture of the rest of the wound was made. An uneventful convalescence ensued. In place of the former hiatus, there was "un véritable plastron osseux." The patient was discharged cured, April 13, 1898.

V. PRAT, in the *Archives de Médecine naval*, Oct., 1885, reported the case of a man who, five years previously, while lifting a wagon, had

felt a sudden sharp pain in the left side. He did not stop work. There was no hæmoptysis. Five days later a tumor the size of a pea appeared. This gradually increased in size and began to be inconvenient.

On June 25, 1885, the tumor had grown to the size of a hen's egg (6 cm. x 3 cm.). It was situated in the ninth left space, 5 cm. from the free border of the ribs. The tumor's volume increased on deep inspiration. The tumor was irreducible, but gave an impulse on coughing. It was tympanitic on percussion.

For the past three years the patient had suffered from irregular attacks of vomiting, accompanied by pain at the site of the tumor. There were also attacks of diarrhœa, not associated with the vomiting. Prat believed the case to be a hernia of the transverse colon and anterior margin of the stomach, causing a partial obstruction of the colon. No operation.

VI. DURAND, at a meeting of the *Société de Chirurgie de Lyon*, Aug. 7, 1904, presented a man, who was stabbed in the left side on April 27, 1903. The wound was located in the axillary line between the ninth and tenth ribs, admitted three fingers, and contained prolapsed omentum. There was no operation at that time. He made a smooth recovery.

One year later, April 27, 1904, he entered the hospital on account of a hernia in the scar. The mass was the size of a fist and gave an impulse on coughing. Reducibility and size of opening not mentioned.

X-ray (Destot) showed that the costophrenic space was obliterated at the level of the wound, and that the free pleural cavity was well above the proposed field of operation. At operation it was found that the hernia contained some omentum, which was resected. The transverse colon was pulled up into wound and again replaced. Layer suture of diaphragm, intercostal space, and skin. Recovery.

VII. DESTOT, at the same meeting, reported a case of Giverdey's, of a stout man in whom a hernia had appeared after coughing. It was located between the eighth and ninth ribs upon the left side. The size varied. Auscultation over the hernia revealed the presence of borborygmi, and, when the patient drank, splashing sounds. Inflation under the X-ray confirmed the diagnosis, that the hernia contained part of the stomach. The patient was made comfortable with an elastic belt.

VIII. SAVARIAUD, *Soc. de Chir.*, Dec., 1905.

In 1898 the patient, a truck driver of 41, was driving a vehicle which collided with an obstacle and rebounded violently.

He did not fall, but experienced a cracking sensation across the small of his back, followed by a sharp pain there. The man rested three months, but even then was unable to resume active work on account of pains in the back.

These pains occurred in crises of great severity, lasting from a few minutes to several hours. They were relieved by local blistering. The patient saw a number of physicians, who regarded his case as one of traumatic hysteria.

Savariaud found a reducible tumor the size of a mandarin orange in the tenth left space in the axillary line. It enlarged and gave an impulse

on coughing. On further questioning, the patient stated that the sharp prow of a boat had struck him there when a child, but he had never paid any attention to the site of injury.

Operation was performed Nov. 22, 1904. After incising the skin, the tumor was found composed of reddened fat distinct from the subcutaneous fat and covered with a cellular fibrous envelope. This fat proved to be omentum. The opening lay in the space between the tenth and eleventh ribs. There was a rudimentary sac around the orifice. The omentum was resected, revealing the spleen at the hernial orifice. A plastic closure of the orifice was effected by using part of the latissimus dorsi. Uneventful recovery.

IX. SCALZI (*Gazette medicale Italo Lombarde*, 1881) reported the case of a man who in 1870 had received 15 stab wounds. One of these, directed from above downward, had divided both eighth and ninth left ribs and perforated the abdomen; it was 5 cm. long. Through this wound a loop of intestine protruded, which was inflamed and distended to the size of an adult fist. The wound was enlarged 2 cm. and reduction of intestinal loop, first into the thorax and then into the abdomen through the diaphragm, was accomplished. The diaphragmatic and intercostal wounds were sutured, an appropriate bandage to lessen thoracic movements was applied, and the patient was kept lying on the left side. He recovered. There was no general reaction, and only a slight local pleurisy.

A hernia gradually developed in the scar. The hernia measured 10 cm. wide by 10 cm. long by 4 cm. high. It was tympanitic, painless, and entirely reducible. There were no symptoms referable to the digestive or respiratory tracts. The man was enjoying excellent health. He drank and ate heartily, and weighed about 250 kilogrammes! (?)

Besides the foregoing cases of Alquier, I have found four more, which are abstracted below.

X. "Medical and Surgical History of War of the Rebellion," Surgical Volume, Part I, p. 515.

Captain R. S., Co. A, 29th N. Y. Volunteers, received a gunshot wound at the battle of Chancellorsville on May 2, 1863. The ball entered the eighth left space, fracturing the ninth rib. The wound was 9½ inches to the left of the ensiform process. There was a hernia of the lung.

Five days afterward (May 7) the ball was voided at stool. The patient made a good recovery and carried his pneumocele without discomfort.

Sept. 19, 1865, he began to have an irritable stomach, vomiting easily, etc.

March 14, 1867, a sudden enlargement of the tumor occurred while the patient was undergoing exertion. The tumor was partly reducible and borborygmi were noted over it. A pad was worn with good effect, so that in 1872 the tumor was much smaller, firm, and solid.

ADDENDUM.—Through the kindness of Dr. W. H. Hartzell of Allentown, Pa., I was able to learn that Captain S. died on August 20, 1893. His widow states that he suffered very much in his later years owing to adhesions of the stomach to the hernia, which protruded between the eighth and ninth ribs on his left side. Cause of death and postmortem findings were not obtained.

XI. LLOBET, *Onze annes de pratique chirurgicale*, Paris, Balliere, 1898. Cit. after Neugebauer, *Arch f. klin. Chir.*, Bd. 73, p. 1014, 1904.

Soldier of 58, who 15 years before had received a stab wound in 8th left interspace between mammillary and anterior axillary lines. A swelling the size of a hen's egg developed at this point.

At operation a thoracoplastic flap was fashioned. The omentum and colon, found in the pleural cavity, were reduced, and the diaphragm was closed by suture. Operative recovery, but patient died six months later from an infection originating in a rib caries.

XII. P. MARZETTI and S. VENANZI, *Il Policlinico, Roma*, 1906, xiii, p. 1554-1556.

A peasant of 70, when 21 years old, had received a stab wound in the ninth left interspace between the mammillary and anterior axillary lines. The wound, which was 2 cm. long, was sutured. The patient made a rapid recovery.

A hernia appeared which gradually increased to the size of an orange. It always was easily reducible.

February 21, 1905, patient came to operation with an ileus of two days' standing. Under cocaine anæsthesia the sac was opened and found to contain omentum and a gangrenous loop of gut. This was resected. The defects in diaphragm and chest wall were repaired. Recovery.

XIII. P. POSTEMPSKI in the *Bull. d. r. Acad. Med. di. Roma*, 1888-89, xv, p. 191, reported the case of a boy with an epiplocele of the left eleventh interspace following a wound there. An intercostal incision sufficed to give adequate exposure (it was not necessary to divide ribs); 10 cm. of omentum were resected, the omental stump was reduced into the peritoneal cavity. The wound of the diaphragm (2.5 cm. long) was sutured with fine silk. Layer sutures of the rest of the wound. No drainage. Recovery.

An interesting feature of this case was the occurrence of a left pneumothorax upon freeing the omentum. Except for a subcutaneous emphysema of the left thorax and left side of the neck, there were no untoward results from this.

*Etiology.*—A study of the cases collected shows that intercostal diaphragmatic hernia has followed wounds from sharp objects or severe contusions along the left free costal border, and has even come on after strains, such as lifting heavy weights or coughing. The ribs may or may not be fractured.

The hernia may make its appearance shortly after the trauma has occurred, or it may develop much later.

*Site.*—The region where these hernias have been observed to occur comprises the anterior parts of the sixth to the tenth left interspaces, inclusive. That is, from the median line to the left midaxillary line, just above the left costal margin. This is a strip which lies between the lower margin of the lung and the free border of the ribs. The trauma causing a hernia in this region usually causes adhesion of the phrenic and parietal pleuræ also, with consequent obliteration of the costophrenic sinus. In this zone, close to the lower margin of the thorax, the diaphragm and intercostal muscles lie close to each other in almost the same plane; hence, rupture of tissue at this point (in the costophrenic space and sinus) favors formation of an intercostal hernia. Higher up, wounds involving both intercostal spaces and diaphragm favor the establishment of pneumothorax and of a diaphragmatic hernia which does not tend to emerge between the ribs.

The presence of the liver on the right side usually prevents the formation of herniæ in a corresponding situation there.<sup>3</sup>

*Anatomy.*—The opening may barely admit the tip of a finger, or may be large enough to permit the introduction of the entire hand. It usually is bounded above and below by the sharp edges of adjacent ribs, and in front and behind by the cicatricial margins of the remaining intercostal muscles in that space. The size of the hernia may vary from that of a pea to that of an ostrich egg.

A rudimentary attempt at sac formation is usually found near the neck of the hernia. Like in other traumatic herniæ, the occurrence of a sac is uncommon, and adhesion of contents is the usual condition.

The contents may comprise omentum, transverse colon or splenic flexure, stomach, or small intestine. These will again be referred to in discussing diagnosis.

*Symptomatology.*—The subjective symptoms may be nil; or, again, there may be much suffering from pain and diges-

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<sup>3</sup> A case which might possibly have been an intercostal diaphragmatic hernia of the right side is described on page 516 of the Medical and Surgical History of the Civil War, Surgical Volume, Part I.

tive troubles due to adhesions, as seen in the case reported by Cloquet, where the patient became so miserable that he was described as presenting a "cachexie herniaire." However, these troubles are common to adhesions of the stomach and the intestines from other causes, and are therefore of no further interest here.

The objective symptoms are those of other herniæ. There may or may not be a scar, depending on the etiology. Increase in size on inspiration, a differential point of value, may not be obtained except in certain positions. In most cases, reduction was easy; in a few it was impossible. Where gut is present and the hernia is reducible, reduction with a gurgle can be obtained at times. The consistence of the herniæ and likewise the findings on percussion depend upon their contents, whether omentum, gut, or stomach.

Over herniæ which contained part of the stomach, typical intermittent splashing sounds were heard when the patient drank. Peristaltic borborygmi could be obtained over a hernia containing gut.

The X-ray is of great service in the diagnosis, even without the aid of bismuth. Much accurate information regarding what parts of the digestive tube are present in the hernia can be obtained by making a series of Röntgenoscopic observations after administration of bismuth carbonate meals and enemata.

*Diagnosis* of the condition is readily established, except where the hernia consists of an incarcerated epiplocele. The fact that the tumor lies *lower* than the inferior limit of the lung is a most important point and one very apt to be disregarded. Reduction with a gurgle, increase in size on inspiration, and the presence of digestive disturbances are not invariable symptoms, but are of great diagnostic aid when present.

Differential diagnosis from such conditions as subcutaneous emphysema, hæmatoma, or pneumocele following a contusion, should not be difficult. Emphysema gives a characteristic crackle, and is usually diffuse; a hæmatoma does not change its size with respiratory movements; a pneumocele lies higher than

the usual intercostal diaphragmatic hernia. Again, even if a pneumocele is of long standing, that part of the lung within the hernia usually remains unchanged,<sup>4</sup> and hence it should be possible to obtain diminution on inspiration, a normal percussion note, crepitation upon reduction, and normal breath sounds upon auscultation.

The differential diagnosis between an irreducible incarcerated omental hernia and an irreducible pneumocele with thickened or atelectatic lung tissue may not be easy. The location of the swelling and the presence or absence of digestive disturbances may serve as clues.

A subpleural lipoma projecting through an intercostal space has been observed.<sup>5</sup> Its occurrence is very rare. It is usually found in the upper thorax, but should such a tumor occur in the lower thorax, there might be considerable difficulty in diagnosis.

*Prognosis* depends upon the same factors as in herniæ in general.

*Treatment.*—Treatment consists in the application of a suitable bandage or truss, or in operation. A glance at the cases published shows that the operative procedure has not always been easy. As said before, there was usually no true sac, and where some sort of sac existed, there were many adhesions between its walls and the hernial contents. The best plan, therefore, is to dissect close to the neck of the hernia and gain an entrance into the free peritoneal cavity. After this, freeing and reduction of the contents can be done more easily and as circumstances dictate. It is well to bear in mind that the gut or pleural cavity may be accidentally opened, and therefore to be fully prepared for such contingencies. The closure of the opening may present certain difficulties. If it is not possible to make a layer suture of the diaphragm and intercostal muscles, owing to an inelastic ring

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<sup>4</sup> Auler, Julius: "Beitrag zur Kenntniss der Lungen brüche," Berlin, 1892.

<sup>5</sup> C. Gussenbauer: Cit. after H. Tillmanns, Lehrbuch der speciellen Chirurgie, 3rd Ed., Part I, vol. ii, p. 605, Fig. 334.

of cicatricial tissue by which the diaphragm and thoracic wall are fused together, the ribs above and below may be approximated, obliterating the space through which the hernia formerly protruded; or, a plastic closure may be resorted to, using fascia, periosteum, or part of the latissimus dorsi.

To sum up, intercostal diaphragmatic herniæ (1) are usually traumatic in origin; (2) they occur mostly on the left side in the anterior portion of the intercostal spaces (sixth to tenth inclusive), a region lying between the lower margin of the lung and the free border of the rib from the midline to the midaxillary line; (3) their symptoms are those common to herniæ in general; (4) the X-ray is of great value in determining the relationship of the various parts of the alimentary canal to the herniæ; (5) the details of operative treatment vary with the findings in individual cases.

It is the writer's opinion that the occurrence of these herniæ is not as rare as the few published communications on this subject would lead one to believe.



# AN EXPERIMENTAL STUDY OF THE MANAGEMENT OF POST-OPERATIVE THORACIC INFECTIONS.\*

A PRELIMINARY REPORT.

BY NATHAN W. GREEN, M.D.,

AND

HENRY H. JANEWAY, M.D.,

OF NEW YORK.

EMPHYEMA of the pleura following some infectious process in the lung is not, as a rule, rapidly fatal. It is generally walled off by adhesions causing a closed abscess. This abscess can be drained and immediate danger of death averted. Purulent pleuritis following surgical trauma is different in its progress, and the event of death is proportional in frequency to the amount of shock accompanying the initial infection. Our own experience demonstrates to us the truth of this statement both from an experimental and clinical standpoint. Death may be caused by one of the following three factors, but usually is due to their combined action:

A. Physical—impairment of the respiratory mechanism, producing either complete or partial collapse of the lung.

B. Physiological—following fatigue of the respiratory apparatus, in part due to physical causes just mentioned.

C. Infectious—due to local and general bacterial invasion.

If we can overcome in the laboratory the combined effect of shock, coupled with one of these aforesaid three, we feel confident that these methods applied to the human being will give better results.

Let us compare the conditions found in the abdomen with those in the pleural cavity. We see here four points of difference. In the case of the pleural cavity, first, there is negative pressure; second, a rigid chest wall; third, a greater motility

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\* Read before the New York Surgical Society, May 10, 1911.

of the viscera; and fourth, there is the tendency to retract rather than to approximate and form adhesions. Sauerbruch and Robinson<sup>1</sup> have dwelt at considerable length upon the importance of this last factor.

If, now, we can by artificial means bring about conditions in the chest approximating those in the abdomen, we may hope for recovery after purulent infections, even as is now the rule in the abdomen.

Not one case of carcinoma of the cardia operated upon by the transthoracic route has been reported that has lived more than five days. The operation has been carefully done, the patient has rallied from the operation, but has died after forty-eight hours from undrained purulent pleuritis. This fact we may not lightly disregard. Drainage of some sort must be established in order that thoracic operations may be more successful. In previous papers<sup>2 3</sup> we have stated that we believe herein lies the solution of this problem. It would be ideal to hope for intrapleural healing without infection and without adhesions of the pleura.

If, now, we look at a suppurative process within the abdomen, we see that one of the conservative steps of the process is the early formation of adhesions. Why not transfer this principle, then, by artificial means to the thorax? How shall we accomplish this? By approximating the visceral and costal layers of pleura and keeping them in apposition until adhesions shall have formed; thus preventing the existence of dead spaces in the pleural cavity.

In looking over the results of this last winter's work, we find that we have operated upon over 50 animals, all under general anæsthesia. We must view our results with an impartial judgment.

Among the procedures which we have attempted, we have tried a permanent drainage of the chest with a tube designed

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<sup>1</sup> F. Sauerbruch and Samuel Robinson: *ANNALS OF SURGERY*, vol. li, No. 3, March, 1910.

<sup>2</sup> H. H. Janeway and N. W. Green: *Deutsche Zeitschrift für Chirurgie*, Band 107, 1910.

<sup>3</sup> N. W. Green: *Surgery, Gynecology and Obstetrics*, vol. ii, No. 5, pp. 512-538, May, 1906.

to be of such diameter that the inflow and outflow of air in the act of coughing was but of small amount, and so arranged that when the dog closed his glottis the lung could be inflated, blowing out fluid and air from the pleura. At the same time the aperture was not large enough to embarrass violently the respiratory act. We have tried, also, intermittent drainage with a permanent tube in place. We have tried permanent drainage with a permanent tube, as suggested by Bryant. We have not yet tried Robinson's<sup>4</sup> very ingenious device for drainage. We have tried intermittent drainage with a tube introduced at intervals, adding, at the same time, positive pressure by introducing the animal's head into the cabinet. We have added to this, also, suction on the introduced tube. We have tried two-way irrigation alone and two-way irrigation with positive pressure. We have also attempted to limit infection to the site of operation by the injection of Hiss's leucocytic extract. (This was partially successful and gave significant findings.)

The animals die with pus in the chest, with collapsed lungs, often with a general infection, or with exhaustion from labored breathing. A number we have saved for a certain length of time.

Where and from what does the infection come? To a certain extent by direct contamination from the opened viscera. We have found, however, that the pleura, if not too long exposed, will stand a severe contamination and the animal will survive. We have opened the chest under differential pressure, and opened the œsophagus, spread around œsophageal contents in the pleural cavity, sutured the œsophagus and closed the chest, and the animals have easily recovered.

Does it come from exposure of the pleura to the air? It does to a certain extent. We have opened the chest under differential pressure, and, without any further procedure, have left it open for two hours, then closing it we have found the dog infected, and the infection ran to a fatal issue.

<sup>4</sup> Samuel Robinson: Boston Medical and Surgical Journal, vol. clxiii, No. 15, pp. 561-570, Oct. 13, 1910.

Is it due to a lowering of the animal's general and local resistance? In a recent article in the *Journal of Infectious Diseases*, Graham<sup>5</sup> states that ether diminishes the phagocytic action of the leucocytes. We have on this account conducted some of our experiments under nitrous oxide and oxygen. We have tried to make our work as rapid as possible, we have padded off the thoracic cavity, we have used sterile almond oil on the tissues to prevent drying, and yet in many cases shock combined with the infection has brought about a fatal issue.

At autopsy we have found quite a uniform picture: pus or seropurulent fluid, complete collapse of the lung upon the operated side with partial collapse upon the other side, adhesions where the lung touched the diaphragm and the site of the operation in the œsophagus, but only few adhesions between the lung and the chest wall. In a few cases examined we have obtained bacterial cultures from the liver.

In cases autopsied more than twelve hours after death there were apparent stitch leaks. In each of three cases autopsied immediately after death, the anastomosis was perfect, as tested by water pressure.

It seems, then, that it is not continued contamination but the result of contamination plus the presence of an area in which the resistance has been lowered, that induces the purulent exudate.

In the case of the animal, we have three things to contend with that do not obtain in the adult human subject. The first is lack of post-operative intelligence; the second, lack of a stable mediastinum; the third, lack of proper cleanliness. If we can overcome these, we stand a greater chance of making our experimental work more successful, and we can transfer our methods to the human species with added confidence.

To overcome these three things in the laboratory, it will be necessary to keep the animal, by some means, quiet for from twenty-four to thirty-six hours, to establish some permanent pressure within the lungs, and to prevent any inward suction

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<sup>5</sup> Evarts A. Graham: *The Jour. of Infectious Dis.*, vol. viii, No. 66, p. 152, Mar. 6, 1911.

of contamination from the wound-surface. It is suggested to establish a permanent differential pressure with the head in either a cabinet or a chamber such as that of Dr. Meyer, or with the thorax in a negative chamber such as the Sauerbruch cabinet. To facilitate getting rid of the purulent exudate, we suggest double current irrigation at the site of anastomosis while pressure is maintained, and we think it advisable to consider all operations upon the œsophagus occupying more than an hour and a half as being infected. We advocate, therefore, drainage to the site of the anastomosis for the first twenty-four to thirty-six hours.

Briefly, a plan which we have as yet been unable to adopt, but which suggests itself from our findings, is this: after the completion of the operation, a drain should be inserted to the bottom of the chest and site of anastomosis, which should be left in place for twenty-four to forty-eight hours. The animal should be given suitable medication to keep him quiet and, at the same time, free from distress. The head should be placed in a cabinet for a sufficient time to allow adhesions to form between the visceral and parietal pleura, and at the end of twenty-four hours a two-way irrigation should be performed down to the site of the anastomosis. After this the pressure may or may not be kept up for twelve hours longer, and on the following day the drainage should be removed.

# THE SURGICAL CLINIC OF THE PROTESTANT EPISCOPAL HOSPITAL OF PHILADELPHIA. \*

REVIEW OF 150 CONSECUTIVE OPERATIONS.

BY CHARLES HARRISON FRAZIER, M.D.,  
OF PHILADELPHIA.

THE series of cases herein discussed represent the surgical experience at the Episcopal Hospital in a three months' service, excluding a not inconsiderable number operated upon by one of the assistant surgeons or internes.

*Morbidity.*—Of the 150 operations of our series almost 100 were for lesions of the abdominal organs. Of the total number there were four deaths, a mortality of about 2.5 per cent. Two of these four deaths, as will be seen, may properly be excluded, so that the mortality may be reckoned as 1.3 per cent. The series include 30 operations for appendicitis and its complications, 22 for hernia, 8 for lesions of the stomach or duodenum, 18 for operations on the pelvic organs with 4 hysterectomies, 4 operations on the biliary passages, 14 upon the urinary organs, and 3 thyroidectomies.

Of the four fatal cases one was a case of tuberculous meningitis, which because of certain focal phenomena was regarded before operation as a brain abscess. An exploratory craniotomy seemed justifiable. The patient survived the operation but a short time, and the autopsy revealed the true nature of the lesion. The second was a strangulated umbilical hernia in an aged patient almost moribund, who scarcely survived the initial incision. These two might be regarded as inoperable.

The third death followed a suprapubic prostatectomy and bilateral herniorrhaphy under spinal anæsthesia in a patient 75 years of age. The patient's condition at the end of the operation was excellent and continued so beyond the period

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\* Read before the Philadelphia Academy of Surgery, May 1, 1911.

at which post-operative shock would have developed. But his vital processes gradually failed, and he died three and a half days after the operation. The fourth of the fatal series was in a patient who had been operated upon for gall stones. This case presented some interesting features and will be alluded to later.

*Technic.*—In the preparation of the field of operation the Grossitch or iodine method was used, preceded by a single preparation with soap, alcohol, and bichloride. The addition of iodine to the technic has so diminished instances of accidental infection that I am disposed to omit altogether any attempt at chemical disinfection with alcohol and bichloride. There was but one frank suppuration in our wounds, and in that instance there were a few small pustules at the site of the wound before the operation to which the infection may be attributed.

In the post-operative period, after operations with incipient or advanced peritonitis, after operations in the upper abdomen, and in all cases of advanced years with few exceptions, the patients were put in the sitting posture for at least 48 hours. This I believe minimizes the incidence of pulmonary congestion and in many instances adds materially to the comfort of the patient.

Proctoclysis was employed wherever for any reason the administration of water or liquids of any character by mouth was prohibited.

*Anæsthesia.*—The selection of an anæsthetic deserves much more attention than it receives at the hands of most surgeons. No matter how skilled the anæsthetizer may be in the administration of ether, there are certain cases where for the comfort and safety of the patient either spinal or nitrous oxide anæsthesia should be employed. While I do not believe nitrous oxide anæsthesia will ever come to be universally used as a substitute for ether, there are many occasions where it is an important factor in the saving of life. In cases of severe toxæmia, where patients are profoundly septic, as in some cases of gangrenous appendicitis, of peritonitis or gangrenous cholecystitis, in empyemata while resecting the rib, in supra-

pubic cystotomy for drainage or stone, in kidney decapsulation or nephrectomies in septic cases, or in strangulated hernias; in all these, as in many other minor procedures, there can be no question as to the value of nitrous oxide anæsthesia. Its safety in competent hands is unquestioned; it relieves the patient of the ether discomforts, but above all it minimizes the risk of operation where life is hanging in the balance and the depressing effects of ether would be enough to turn the scale. Where abdominal relaxation is necessary, ether is substituted for a few moments until relaxation is obtained, returning to nitrous oxide.

Spinal anæsthesia, too, has its special indications, it seems to me, particularly in patients with pulmonary tuberculosis and in elderly people, where, because of valvular lesions or myocarditis, the administration of nitrous oxide may be not unattended with risk. In this series I used spinal anæsthesia in the following operations: a colostomy for inoperable carcinoma of the rectum; suprapubic drainage of a large abscess of the pelvic region in a septic patient; in a laparotomy for tubercular peritonitis and another for cirrhosis of the liver; in a suprapubic cystotomy; in a suprapubic prostatectomy; in the repair of a vesicorectal fistula. Scopolamine gr. 1/150 two hours before and morphine sulphate, gr. 1/6 one half hour before the operation so benumbs the sensibility of the patient, that, though conscious during the operation, he suffers from none of the ill effects which might come from fright in a wide-awake patient. From spinal and nitrous oxide anæsthesia there were no ill effects. The only serious complication occurred in an operation for hydrocele. The patient was an alcoholic; after a considerable quantity of ether had been administered without avail, chloroform was substituted, and just as the incision was made the heart stopped beating. Cardiac massage was resorted to by the transdiaphragmatic method, and in the course of a few moments feeble fibrillary contractions could be felt. Gradually the cardiac contractions became more perceptible and regular, and after ten minutes resuscitation was established. The abdominal wound was

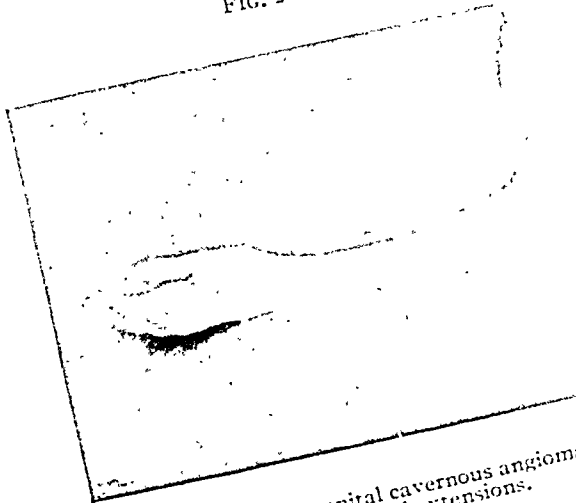


FIG. 1.



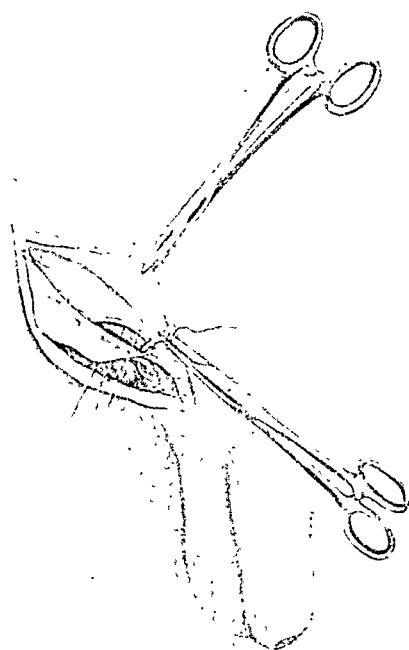
Photograph showing a fibrolipoma of the sartorius muscle mistaken before operation for a hernia. Note protrusion on the anterior surface of the upper portion of thigh.

FIG. 2



Photograph of a congenital cavernous angioma of the hand with digital extensions.

FIG. 3.



Application of the sutures in the operation for radical cure of inguinal hernia.

FIG. 4

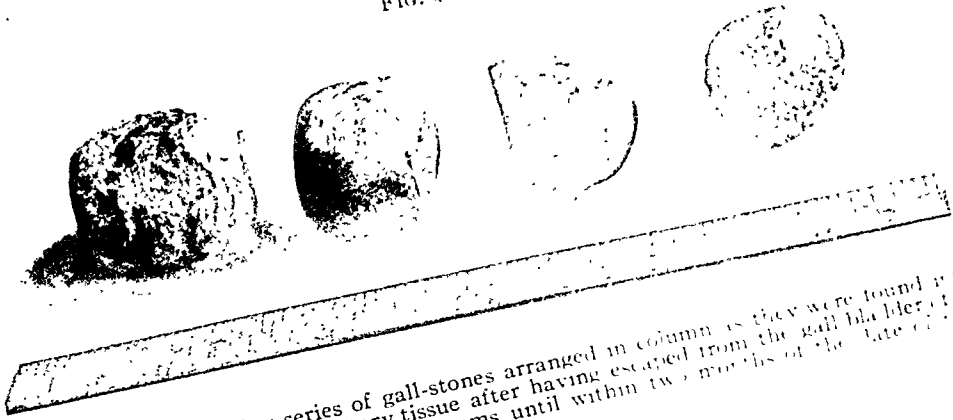


Illustration showing series of gall-stones arranged in column as they were found embedded in a mass of inflammatory tissue after having escaped from the gall bladder of a patient who had been free from symptoms until within two months of the date of operation.

FIG. 5.



Portion of stomach removed, showing in centre of specimen ulcer on the lesser curvature



closed, and the operation on the hydrocele completed. The patient suffered no relapse, and the subsequent course of events was uneventful.

*Tumors.*—Curiously enough the district upon which the hospital draws for its material is not a fertile one for tumors. Relatively speaking there are few operations for cancer, exclusive of the uterus, and I have often attributed the paucity of malignant cases in the clinic to the popular impression among the less enlightened classes, that cancer is a disease of the blood and removed by operation always returns in some other place. Of the benign tumors there were three unusual enough to deserve mention. One was a lipoma in the belly of the sartorius muscle, about eight inches below Poupart's ligament (Fig. 1). The tumor protruded above the surface only when the patient contracted the muscle. On first examination the character of the lesion was not suspected; it was thought to be a muscle hernia. The second was a tumor of the breast, which, because of the associated enlargement of the axillary lymph-nodes, was thought to be either carcinoma or chronic cystic mastitis; but upon histological examination proved to be a fibroma. In the third case there was a large congenital angioma involving the palmar surface of the hand (Fig. 2) with digital extensions.

*Appendectomies.*—In the management of the appendix cases no hard or fast rules were laid down. It was not our practice to attempt to classify our cases as early or late to gratify the statistician, according to whether they were operated upon in the first 48 or 72 hours or later. In the acute cases with few exceptions the operations were performed as soon as the diagnosis was made. To this general rule there were certain exceptions. When the patient was first seen at the end or near the end of a mild attack we consulted our convenience as to the time of operation. Furthermore we advocated the starvation plan in a few cases of the following type: usually some time has elapsed since the onset of the attack; it may be only two days, more likely, however, three to five; the patient looks toxic, he is toxic; his pulse is rapid, over 120; the abdomen is distended and more or less

tender everywhere; peristalsis has been altogether or partially arrested, perhaps reversed with vomiting; restlessness and anxiety are written on the patient's face. In other words the infection is a wide-spread one. Sometimes this picture develops earlier, sometimes later, but whenever it comes I am convinced that the best results will be obtained by conservative practice, *i. e.*, by privation as to solids or liquids by mouth, proctoclysis, and posture.

One often hears or reads of bitter disputes as to whether the time limit between the early and late cases should be placed at 48 hours or later. Such discussions are futile, for early or late are but relative terms when applied to a given case. Each case must be a law unto itself, and no rules can be laid down comprehensive enough to allow for the innumerable variations.

It has been said, and very properly, that appendicitis is a surgical disease; no one denies it. The surgeon reserves as his privilege the right to decide upon the operability of a given case; that privilege is usually accorded him. In the exercise of this privilege he selects some cases for the Ochsner treatment and some of those cases may—before being operated upon—die. In the publication of his mortality statistics the surgeon usually excludes these. I believe, however, the time has come when the only means of determining the morbidity of appendicitis is to include in our death-rate those treated by both conservative and operative measures. We used to throw the responsibility on the medical men for all unoperated cases. But we cannot consistently do this any longer, if we take the stand, as I believe we should, that appendicitis is a surgical affection first, last, and always, and reserve the right ourselves to set aside a certain group, as I also believe we should, for conservative treatment. Having assumed entire responsibility for all cases, we must include in our statistics the fatal results in the unoperated as well as operated cases.

Irrespective of the appendices removed incidentally at other operations, there were 30 removed which were found at operation or in the laboratory to be diseased. There were no

fatalities in this series, but *apropos* of what has just been said of the mortality statistics I should refer to the case of a young man, who when first seen on the fifth day of the disease, was desperately sick. I declined to operate, and watched him carefully from day to day. Under the treatment prescribed his improvement with each 12 hours was marked, until four days later the distention had subsided to a marked degree, his tenderness had become circumscribed to the right iliac fossa, the pulse fell to 70, and the clinical picture was transformed from one of general to one of local peritonitis. I had planned to operate on the following day, but in the course of the early morning hours, the patient without warning developed signs of collapse from which he did not rally. No autopsy was performed and the cause of death was a mystery. At the same time it should occupy just as conspicuous a place in my statistics as a death following operation.

The technic of the operation calls for little if any comment save with reference to the matter of drainage. In this I find myself using drainage in an increasingly smaller number of cases, and when drainage is required using less drainage material, rarely anything but split rubber tubing with a wick of gauze. The fundamental principle in draining the peritoneal cavity is the relief of pressure afforded by the opening in the abdominal wall. This need not be larger than to accommodate one or two full sized drainage tubes. I no longer have a wound entirely open and filled with gauze, and I close wounds without drainage sometimes even when there is a small accumulation around the appendix, thoroughly disinfecting the region with alcohol.

*Hernia.*—Of the hernia series there were 22 cases, of which 13 were indirect and 3 direct inguinal, 2 recurrent, 1 femoral, 2 ventral, and 1 umbilical. There were no unusual types except an irreducible omental hernia in a young adult, a case in which the diagnosis was not established until the operation. Without impulse it presented the earmarks of a lipoma. Of the series there was one fatal case in a large strangulated umbilical hernia of four or five days' duration, in the person of an aged woman who was generously referred to my service

by a practising surgeon of a neighboring hospital. The patient was almost moribund at the time, and did not more than survive the hasty attempt to expose and free the contents of the sac.

The method of procedure in the inguinal type varied according to the character of the hernia; in some instances the simple Ferguson, in some the Bassini, and in others the imbricating method of Andrews was used. In the selection of the method I have always tried to observe the general principle of disturbing in the least degree the normal anatomical relations. Thus in the hernias of children and the incipient hernias of young adults where the rings are not large and the musculature all that could be desired it is not necessary to transplant the cord. After isolating the sac and freeing the neck from its attachments and ligating it an inch beyond the margins of the internal ring, the internal oblique and conjoined tendon were sutured to Poupart's ligament without transplanting the cord; and the wound in the external oblique sutured without imbrication. In complete hernias of longer duration with larger rings the Bassini method was adopted. The remaining group included hernias of still longer duration, where the rings are more or less approximated, all direct hernias, all hernias in elderly people with musculature flabby and without tone, and hernias in which the conjoined tendon is altogether obliterated. Here I invariably resorted to the imbricating method of Andrews, in some cases splitting the sheath of the rectus and using either the belly of the muscle or flap of the sheath to fortify the defective area at the lower portion of the canal. This operation in this particular group is vastly superior to the Bassini method and should always be given preference. In all the operations, the incision in the external oblique is made a little above, instead of directly over, the canal and carried down as Judd recommends above and to the inner side of the internal pillar of the external ring so as to leave this structure intact. In introducing the deep mattress sutures in the reconstructive stage, my practice differs somewhat from the conventional procedure, in that I introduce the needle from the external aspect of



the shelving edge of Poupart's ligament, and the knot is tied in the outer rather than the inner aspect (Fig. 3). This is a matter of but minor consideration, but has been adopted because it avoids the splitting or tearing of the edge of Poupart's ligaments, which sometimes happens when traction in the suture is made to approximate the edges. For this suture I prefer to use a double strand of No. 0 or No. 1 catgut to a heavier single strand, as I always feel a little more confident of the sterility of the finer material.

We are gradually being weaned from the tradition that gall-stones are innocuous in many instances throughout life to be discovered only at autopsy. That many cases of cholethiasis have been treated for many years for stomach trouble we know too well, but in exceptional instances one runs across a patient in whose history there is nothing either indicative or even suggestive of the existence of gall-stones.

Such was the case in K. S., aged fifty, who told me she had never been sick in bed, that she had never been treated for dyspepsia, and had none of the digestive disturbances so common in cholelithiasis much less any of the acute exacerbations of biliary colic or subacute cholecystitis, at least until two months before the operation, when she had attacks of pain in the upper abdomen which had confined her to bed for a while. I questioned her myself with great care, as the physical signs pointed to the biliary passages. There was a mass in the abdomen about the size of a fetal head, extending from the margin of the ribs to the umbilicus. It did not move freely with respiration, and was not continuous with the margin of the liver. Through a right rectus incision I came down at once upon a mass, surrounded by adhesions, which were separated with great difficulty. Finally a cavity was opened containing pus and four large gall-stones (see Fig. 4). These were firmly imbedded in the inflammatory mass, arranged in single column, and faceted at either end where they were in direct contact. There was no escape of bile at any time, and nothing which could be identified as a gall-bladder was seen. The gall-stones, which must have been there months if not years, had ulcerated through the gall-bladder and became imbedded in a mass of inflammatory tissue. For two days the patient's condition was most satisfactory, but on the third day there was for

the first time a copious discharge from the wound, which was believed to be bile. On the fourth day 90 ounces of this fluid were collected.

Her pulse was growing more rapid and weaker, her skin leaky. I was at a loss to account for her rapidly failing strength. I began to suspect the fluid draining in such quantities was not pure bile; specimen examined disclosed hydrochloric acid, and further investigation pointed to a fistulous communication with stomach and duodenum, probably resulting from the trauma incidental to the liberation of the gall-stones from the inflammatory bed. The patient was taken to the operating room again, and through a left rectus incision our suspicions were confirmed. The tissues about the perforation were so fragile that it could not be satisfactorily closed with sutures. Accordingly a gastrojejunostomy was performed and the pyloric outlet closed. The patient did not react and died the following day. Had the true nature of this lesion been recognized sooner, I cannot but feel she would have survived the second operation.

Of the lesions of the upper digestive tract there were in all nine cases, two gastric carcinomas, two gastropnoeses, three gastric and two duodenal ulcers. All were operated upon and there were no fatalities. It is interesting to note that in the ulcer cases the proportion of males to females was four to one, a further evidence of the greater prevalence of ulcer in the male sex.

Before discussing the operative procedures in this series I will refer to some interesting facts bearing upon the diagnosis and symptomatology.

In one case, B. F., an engineer, fifty-five years of age, the pre-operative diagnosis was cholelithiasis. There was a history of stomach trouble covering a period of two years, with bilious attacks and occasional vomiting; the patient stated that he had been jaundiced off and on, that his stools had been clay colored, and that discomfort followed eating. There was some rigidity and tenderness over the gall-bladder, and the scleræ were jaundiced. At the operation a typical saddle-back ulcer was discovered, with an unusually extensive infiltration of the gastro-hepatic omentum. To the encroachment of this upon the common duct we attributed the signs of obstructive jaundice which led

us astray in the diagnosis. The ulcer-bearing area with a portion of the gastrohepatic omentum was resected, and all the symptoms, including those of common duct obstruction, disappeared (see Fig. 5).

The unreliability of the gastric analysis in the diagnosis of gastric or duodenal ulcer or cancer was forcibly illustrated in our cases. As to the presence of hyperacidity or of occult blood in the contents of the stomach or bowel, I am becoming more and more convinced that to wait for such laboratory indications of ulcer is unjustifiable in the presence of a reasonably clear history. It is after all the history upon which we must place the most reliance, and upon which our decision for or against operation must be founded. Unfortunately the "history," so called, is often not an accurate record of the development of the disease in chronologic order, but a collection of isolated facts forced from the patient by a system of cross-examination at the hands of one who often approaches the case with preconceived notions as to the diagnosis and conducts his examination accordingly. A better term, as some one has recently pointed out, is anamnesis, which implies a record of the disease from the patient's recollection, and if the patient is intelligent enough it should be written by the patient and not for him. That one may sometimes be misled, however, by the history is shown in my experience with a young woman evidently neurasthenic in temperament. Although skeptical about the existence of a gross lesion, I was finally persuaded to explore the upper abdomen, because of the very positive evidence of hæmatemesis and of aggravated attacks of vomiting and pain. The findings at the operation were negative and I ascertained afterwards from the patient that she was in the habit of sucking the gums till they bled, swallowing the blood, and then inducing vomiting. Hence the hæmatemesis.

To me an interesting case, because of the difficulty in diagnosis and the duration of the disease, was of a young man then thirty-one years of age, who had been ailing twenty years off and on; at the age of eleven he had an attack of vomiting with abdominal pain which confined him to bed for ten days; and even

prior to that time had what he called indigestion. He had served in the army during the Spanish War, and since then had worked steadily as a machinist. His work had never been interrupted, he ate everything, had never vomited, and never had any blood in stools. His chief and only complaint was pain, worse when the stomach was empty, often having to get up at night for a glass of hot milk or water. There was no occult blood, no hyperacidity, no dilatation of stomach. He was tender over his epigastrium but he was tender also over his appendix. Although the clinical picture did not conform altogether to type, I thought we were dealing with a case of appendicular dyspepsia, a chronic appendix with gastric symptoms, and proceeded accordingly. Through a gridiron incision I explored the appendix, and found it buried in a mass of adhesions, and liberated it with much difficulty. Though there was no doubt as to the existence of a lesion of the appendix, I was still in doubt about the upper abdomen, which I explored through a right rectus incision and found the stomach and omentum plastered to the parietal peritoneum, and on further investigation an ulcer of the lesser curvature. From the extent of the peritoneal invasion there had evidently been at one time some leakage. The operation concluded with a gastrojejunal anastomosis. Recovery was uneventful.

The method of procedure in gastric ulcer necessarily varies. However, I strongly advocate excision of the ulcer when this is feasible, and especially in the large indurative type, including the saddle-back ulcer in patients approaching middle life. It is in this type that carcinoma is most frequently implanted, and for this reason alone, if for no other, we owe it to our patients to practise the more radical procedure. These ulcers should be looked upon as precancerous conditions and treated accordingly. When the ulcer is so situated or so adherent to adjunct structures as to make excision difficult, the pyloric outlet of the stomach should be closed by infolding as the surest safeguard against recurrence and as the most rational way (in the light of our present knowledge of the pathogenesis of ulcer) of securing permanent results. The same practice is indicated, I believe, in duodenal ulcer as well, although in my experience the tendency to recurrence in the latter is not as great as in gastric ulcer. The operations

in this series of gastric cases were carried out according to these principles. In technic the no-loop gastro-jejunostomy, vertical opening was used, the line of sutures protected as Mr. Moynihan suggests with the gastrocolic omentum.

The management of actively bleeding ulcers requires the exercise of one's discretion. Ordinarily I favor palliative procedures.

For example one of our patients, a young woman of twenty-two, with a five-year ulcer history, had three large hemorrhages in five days, once vomiting three quarts and with a large quantity of blood in the stools. On admission she looked exsanguinated, her hæmoglobin was low. I decided not to operate at once, ordered 20 cc. of horse serum given hypodermatically, morphine q.s. to allay pain and restlessness, and small quantities of saline solution by bowel, and an ice bag to the abdomen. After five days of freedom from hemorrhage or vomiting I operated and found an ulcer on the greater curvature. If, on the other hand, the plan of treatment had been of no avail and hemorrhages recurred, with increasing frequency or in increasing amounts, there would then have been but one recourse, immediate operation.

Of the pelvic cases, in fact of the entire series, the most puzzling was in the person of a patient fifty years of age referred to me by Dr. E. F. Walsh. She told me that she had not been well since the birth of her last child three years ago, and prior to that had had one miscarriage, that her menstruation had been regular until the last period now two weeks overdue. She laid emphasis on troublesome attacks of indigestion with vomiting, for which her physician had treated her from time to time. Eight days prior to admission, after a hearty meal, she was seized with a violent pain and vomited. For the next three days vomiting continued but the pain was less severe. She remained in bed with a normal temperature on a liquid diet and on the day before admission she had had another attack of severe pain similar to the first. When I saw her she appeared exsanguinated, her hæmoglobin was 20 per cent., the leucocytes 22,400, and pulse 140; the abdomen was distended, and she referred her pain to the epigastrium and precordium. My first thought in view of the history of digestive disturbance, the intense pain, and attacks of vomiting was hemorrhage from a duodenal ulcer. In

her present condition operation seemed out of the question, so I watched her carefully day by day and gradually the symptoms of the upper abdomen disappeared and were replaced by an area of dulness and tenderness in the lower abdomen. To make a long story short, when her condition justified it I opened the abdomen and found we were dealing with an ectopic gestation. From a pint to a quart of partially organized blood-clot was removed together with the sac. There was no post-operative shock, and convalescence was rapid and uneventful.

Unfortunately the Episcopal Hospital is so far removed from the center of the city as to be inaccessible both for the casual visitor and student alike. This isolation is a great drawback, as there is nothing so stimulating to the whole staff of a hospital, from the highest to the lowest officer, as the constant criticism and searching inquiry of those who are seeking useful information in modern methods of procedure. Because of its isolation the physical equipment of the hospital is known to few of the profession, resident and non-resident. Perhaps the most favorably situated of the larger hospitals for service to the working classes, it has a wealth of material representing the whole field of surgery. Of the lesions of the extremities, there is an extraordinary opportunity to study fractures of every description, and of the abdominal lesions there is a veritable mine of examples of inflammatory conditions of the pelvis, most of which are the result of improper care at childbirth at the hands of incompetent midwives or the patients themselves. To the philanthropically inclined I know of no better object for investment than the establishment of a maternity department for the poor of that district.

The service of this hospital, as of many others, is an interrupted one. The disadvantage of this system pertaining in many institutions is well recognized and so patent as to admit of no dispute. Far better is the European system, where in each hospital a limited number of surgeons devote their entire time to the instruction of young physicians and surgeons and the utilization of the material at their command for the advancement of medicine as a science and an art.

# TRANSACTIONS OF THE NEW YORK SURGICAL SOCIETY.

*Stated Meeting, held May 10, 1911.*

The President, DR. ELLSWORTH ELIOT, JR., in the Chair.

## ŒSOPHAGOSCOPIC AND GASTROSCOPIC EXAMINATIONS.

DR. HENRY H. JANEWAY (by invitation) and DR. NATHAN W. GREEN demonstrated the use of the gastroscope, and made some observations upon its surgical use and value.

DR. HENRY H. M. LYLE said that in hospitals it had been no easy matter to induce patients to submit to gastroscopic examinations, but, as a matter of fact, his own observation and experience had shown him that the procedure was not at all difficult. The larger tube of Mikulicz was somewhat harder to pass than Chevalier Jackson's; on the other hand, the Mikulicz tube was superior to that of Jackson for the purpose of removing sections, as it gave a better view in some respects.

DR. JANEWAY, in reply to a question, said he had never seen severe bleeding after the removal of sections from the cardia or œsophagus. After removing the section and mopping with a bit of cotton, the hemorrhage, as a rule, was not severe enough to interfere with the view.

In connection with this paper, Dr. Janeway said he wished to make it clear that it was merely a preliminary report, but that it indicated a successful solution to a problem which ought to be solved.

The confirmation of the diagnosis by the removal of bits of tissue in so large a proportion of the cases of carcinoma of the stomach was presented with some hesitation, inasmuch as the series of cases was as yet too small to enable one to judge whether subsequent experience would be so successful.

AN EXPERIMENTAL STUDY OF THE MANAGEMENT OF  
POST-OPERATIVE THORACIC INFECTIONS—  
A PRELIMINARY REPORT.

DR. NATHAN W. GREEN and DR. HENRY H. JANEWAY read a paper with the above title, for which see page 549.

DR. WILLY MEYER said there could be no doubt of the fact that, since the introduction of the differential pressure apparatus the thorax could be simply and safely opened. In a number of instances he had been struck by the fact that the patients stood the operation very well, but that on the second day signs of dyspnoea and cyanosis appeared, sometimes with fatal results. In one of the earlier cases operated on at the German Hospital, where both pleural cavities were opened, and the thoracic incision closed air tight, the patient did very well for sixteen or eighteen hours after the operation; he then became profoundly cyanotic, and before he could be brought back under the influence of the differential pressure, where the wound could have been reopened, if necessary, he passed away. In that case there was a carcinoma of the œsophagus, and a resection of the latter had been done. The patient was a man, sixty-four years old, and the operation was quite a severe one. At the post-mortem examination, both pleural cavities were found filled with a large amount of sero-sanguinolent fluid, and the lungs were compressed and collapsed.

This and subsequent cases, Dr. Meyer said, had convinced him that besides doing the actual work under differential pressure, we had to learn to drain these wounds. In the new pavilion for thoracic surgery at the German Hospital, arrangements had been made for two recovery rooms, which were located adjacent to the differential pressure apparatus, and here patients who had been operated on under differential pressure were kept for twenty-four or forty-eight hours after the operation on special beds which were of the same height as the operating table and unobstructed at the head-end, so that if necessary the head of the patient could be readily placed in the differential air chamber. The pressure of the airlock gave free access to the patient's head for purposes of feeding, etc., by the relays of assistants and nurses.

Dr. Meyer said he appreciated the fact that the differential pressure method, as carried out at the German Hospital, was only one way of permitting surgeons to enter the thoracic cavity safely.



Other methods were known and other solutions of this problem would probably come to light. But whether or not intrathoracic work would have a successful issue would depend not only on the surgical technic itself, but on the proper after-management of the patient, especially on drainage of the thoracic cavity.

DR. GREEN said that in the course of their experiments on animals, Dr. Janeway and he had noticed the same phenomenon mentioned by Dr. Meyer, namely, that in some instances after an intrathoracic operation the animal would progress favorably for sixteen, twenty-four or thirty-six hours, and would then begin to suffer from increasing dyspnoea and rise of temperature, followed by death. At the autopsy they found the lungs collapsed and the pleural cavities filled with a serosanguineous fluid. The speaker said he thought the collection of this fluid was undoubtedly due to the exposure of the pleura to the atmosphere for too long a time.

Dr. Green said he thought that Dr. Meyer's idea of immediately returning these patients into the differential pressure chamber upon the onset of these unfavorable symptoms was an excellent one. This would keep the lungs expanded, so that they would approximate the chest wall until adhesions should have formed; the track of the operation might then be easily drained.

#### REMOTE RESULTS OF RESECTION OF THE AORTA AND TRANSPLANTATION OF VESSELS.

DR. ALEX. CARREL read a paper with this title.

# TRANSACTIONS

OF THE

## PHILADELPHIA ACADEMY OF SURGERY.

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*Stated Meeting, held May 1, 1911.*

The Vice-President, DR. JOHN H. GIBBON, in the Chair.

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### RESULTS AFTER REMOVAL OF AN EPITHELIOMA OF THE MANDIBLE, INVOLVING THE FLOOR OF THE MOUTH, THE CONTIGUOUS SURFACE OF THE TONGUE, AND THE GLANDS IN THE DIGASTRIC TRIANGLE WITH LIGATION OF THE EXTERNAL CAROTID.

DR. ADDINELL HEWSON presented a man, aged fifty-four years, who, when first seen February, 1909, presented a growth extending from the median line, on the left side, surrounding the roots of the central left lateral incisor and first bicuspid teeth, and extending into the floor of the mouth. It was of almond shape, ulcerated, and in the last six months had bled slightly. Enlargements in the digastric triangle were distinctly palpable. The growth had been very slow, but in the last two weeks had been rapid. The urinary examination was negative, and the blood examination showed no marked leucocytosis. The hæmoglobin was 87 per cent. Slight increase in the lymphocytes and decrease in the polymorphonuclear neutrophils. The left external carotid artery was ligated as a preliminary to the operation. The incision for the removal of the growth was made in the median line and carried along the caudal margin of the mandible as far as the facial growth. A stout ligature was passed through the tongue, and a Gigli saw introduced, severing the mandible at the right canine tooth. The saw was again introduced, severing the mandible ventrad to the left facial growth, thus permitting the tongue floor of the mouth to be in the grasp of the part removed. The incision was now completed, removing a portion of the growth

on the under surface of the tongue, the mylohyoid muscle, the attachments of the glossal and suprahyoid muscles, and the contents of the digastric triangle without involving the incision for the ligation of the left external carotid artery. The glossal muscles and the suprahyoid muscles were fastened to the remainder of the mandible on the right side, the margins of the tongue to the remains of the caudal fornix of the vestibule of the mouth, the wound closed with interrupted sutures, and a wick introduced in the bottom of each wound. The wound healed with slight stitch abscess, but there was no involvement of the carotid incision. The pathological report of the growth showed the presence of infiltration in the pearly bodies, also some infiltration into the tissue in the floor of the mouth and into the mucous and salivary glands. Some epithelial cells were found in the lymph-glands, and in some there was no infiltration whatever. The patient had an uneventful recovery, and was able to leave the hospital April 1. There was a slight recurrence in May, 1910. process about the canine tooth, which was removed in May, 1910. Microscopically, this growth proved to be a slight recurrence. There was, at this time, no enlargement anywhere; patient's health was good, although absolutely adentulous, and compelled to eat soft food. In December, 1910, he reported, complaining of a small tumor about the size of a chestnut in the right supra-clavicular region, which was very painful on manipulation. However, no manifestation of any connection with the mouth, and the swelling was treated as a result of cold and soon disappeared. This proved to be a fact, as, when the patient next appeared this growth had disappeared. At this date, May 1, 1911, there has been absolutely no return anywhere. The contraction of the muscles had produced rather a pointed chin, and the interval between the severed portions of the mandible was just the breadth of a finger. The tongue can be protruded to its normal length from the mouth, and the voice sounds give the impression of the patient lisping with a quid of tobacco in the mouth.

## THE TREATMENT OF LACERATED AND INCISED WOUNDS OF THE EXTREMITIES, WITH REPORT OF FIVE TYPICAL CASES.

DR. JAMES A. KELLY read a paper with this title.

## ANÆSTHESIA BY THE INTRATRACHEAL INSUFFLATION OF AIR AND ETHER.

Dr. CHARLES ELSBERG, of New York, by invitation, read a paper with this title.

Dr. W. W. KEEN said that eighteen months ago he had the pleasure of seeing Dr. Carrel at the Rockefeller Institute do a remarkable series of operations upon animals, using this method, with a very simple apparatus. The etherizer used the foot bellows, and there were two tubes, one going directly into the respiratory tube while by the other the air passed through a bottle of ether, with a clamp on each. Thus pure air or air with ether vapor could be used in any proportion. It was startling to see Carrel with one sweep of a large knife open widely both thoracic cavities, exploring lungs, heart, and pericardium without the slightest trouble. There was no disturbance of the circulation nor any change in the color of the animal so far as one could judge. Carrel was able then to handle the lungs and displace them and the heart freely. He then severed and anastomosed the aorta, first clamping the aorta above and below the point where he did the anastomosis. He had intended originally to introduce a piece of vena cava that had been in cold storage for a number of days, but the specimen proved not to be a good one, and finally he had to abandon this and sutured the two ends of the aorta to each other. The œsophagus was fully exposed and handled. The operation took about an hour and a quarter. The dog at no time was in the slightest apparent danger of death. The lungs were pink, and whenever it was deemed necessary a little more pressure was put on or the pressure was diminished at will, and finally when the operation was completed the lungs were considerably distended to displace all the air in the thoracic cavity, the walls of the thorax were sutured in layers, and in the course of two or three minutes after the conclusion of the operation the tube was withdrawn and the dog was breathing as naturally as if an abdominal and not a thoracic operation had been performed. Dr. Keen was very much struck at the time with the simplicity of the operation, with the possibility of doing almost any operation by means of this method. It is a vast improvement over the expensive differential pressure chambers. The usefulness of this apparatus will be broadened very much.

Dr. CHARLES H. FRAZIER said that he had recently witnessed

than appendix vermiformis.





## GIANT APPENDIX.

a demonstration of this apparatus by Dr. Elsberg and he had been impressed with its effectiveness and the apparent freedom from risk. The operation, an appendectomy, was being performed by Dr. Elsberg's assistant. Dr. Elsberg gave his attention wholly to the apparatus which worked perfectly, and while it appears rather complicated, one should readily master its mechanism. It will replace general anæsthesia by the ether drop method in a number of instances, particularly in thoracic operations, in all operations in which the patient is in the prone position (face down) as well as in those about the buccal cavity where there is always danger of the possibility of the inhalation of blood with inhalation anæsthesia. Dr. Elsberg has shown by experiment that the force of the outgoing air is sufficient to prevent particles of blood, or as he used in his experiments lampblack, entering the trachea or bronchi. This is a very practical consideration and should not be lost sight of.

## GIANT APPENDIX.

Dr. JOHN A. JOPSON showed a giant appendix vermiformis. The patient from whom he had removed it was a woman about fifty-eight years of age, exhibiting the symptoms of acute appendicitis, and who was operated upon the fourth day after the onset. The appendix was retrocæcal, pointing upward and adherent to the posterior surface of the cæcum and colon, and from its peculiar shape, size, and color, not easily recognized. It was separated from its attachment to the posterior wall of the cæcum, and when turned downward appeared as a large pouch communicating with the extremity of the cæcum, which was rather short. It lacked a mesentery, was white in color, and apparently undergoing necrosis, a sharp line of demarcation being present at its base. The base was crushed, ligated, divided, and the broad stump inverted by interrupted sutures. A drain was left in the wound to guard against leakage, but none occurred, and the patient, who suffered from chronic nephritis, made a good recovery. The appendix, which was quite empty, measured 7.5 cm. in length, by 4 cm. in diameter (Fig. 1). The wall was nearly a centimetre thick at the base, and there were two points of beginning perforation at the tip. Microscopic examination of sections was made by Dr. Speese, who furnished the following report: "The examination does not reveal any glandular tissue

or any structure which is suggestive of the same. To some extent the section resembles the normal structure of the intestine, in that some lymphoid tissue is present and arrangements suggestive of the normal coats of the intestine. The outline of these areas is, however, greatly distorted, and the muscle tissue separated by granulation tissue, dense in structure and apparently of long standing. There is an organized exudate or what appears to be the serosa, and throughout the appendix blood-vessels are distended and leucocytic infiltration points to an acute exacerbation. It is noteworthy that many eosinophilic leucocytes are present in the tissues. The examination discloses a process which resembles the lesions of acute and chronic interstitial appendicitis."

The appendix in this case would seem to be a reversion to a primitive type, in which the differentiation between the cæcum and appendix was much behind that normally observed in the human subject. It was interesting to compare it with those observed in some of the lower animals, as figured in Huntingdon's diagrams, reproduced with additional drawings in Kelly and Hurdon's work. In their shape and proportions the cæcum and appendix in this case resembled somewhat those normally present in the aard-wolf, the harbor seal, the collared peccary, and the American tapir.

#### THE SURGICAL CLINIC OF THE PROTESTANT EPISCOPAL HOSPITAL.

Dr. CHARLES H. FRAZIER read a paper with the above title, for which see page 554.



## CORRESPONDENCE.

### SPLINTING SKIN GRAFTS AND GRANULATING SUR- FACES.

EDITOR ANNALS OF SURGERY,

Dear Sir: Supplementing the paper by Dr. John S. Davis in the March, 1909, issue of the ANNALS OF SURGERY, I may say that since October, 1906, it has been my practice to dress burns, ulcers, blisters, and skin grafts with a protective made by dipping Brussels net into a mixture which renders it non-absorbent. This allows any ordinary dressing to be used, as all discharge escapes through the openings of the mesh into the outer dressings, and the net itself adheres neither to the wound surface nor to the dressings.

The first mesh I used was made by dipping the net into a xylol solution of crown dental rubber, but during the past two years I have used a mixture of white wax, laundry paraffin, and turpentine. This is equally efficient and infinitely cheaper, does not deteriorate, and can be prepared with much less trouble.

An average formula is as follows: white wax, two ounces; laundry paraffin, four ounces; turpentine, two ounces. Melt the wax and paraffin together, then add the turpentine, and bring slowly to a boil, now dip the Brussels net (previously sterilized) into the boiling mixture, for if the net is dipped when the mixture is not boiling films of wax form across the openings. Place in a solution of mercury bichloride 1:100 until required for use. Before using wash with sterile saline solution (warm but not hot).

Simple as the material is, it saves an immense amount of suffering for the patient and time for the dresser. Mesh of different sizes will be required for different cases, and the proportions of the ingredients may be altered for different conditions.

H. H. SINCLAIR, M.D., C.M.,  
Walkerton, Ont.

August, 1911.

## OPEN TREATMENT OF FRACTURES.

EDITOR ANNALS OF SURGERY:

In the ANNALS of September, 1911, on page 407, there is attributed to me a statement in a discussion of Dr. Edward Martin's paper on "The Open Treatment of Fractures," read at the meeting of the American Surgical Association, which conveys an erroneous impression. I am made to say, "Equally good results can be obtained by the ordinary old-fashioned pulleys with Buck's extension."

I said that, instead of using a one hundred pound weight for reducing the opened fracture, as suggested by Dr. Martin: "Equally good results (in overcoming the over-riding before applying the plate and screws) can be obtained by the ordinary old-fashioned *compound* pulleys, attached to the limb with Buck's extension apparatus."

I at the same time reported a case, wherein I had used this method, because the ordinary Buck's extension method with pulley at the foot of the bed was valueless. The fracture was such as required me to open and use plates and screws.

Any practical surgeon will at once see the dissimilar significance of these two similar sentences. The first is untrue, the second is true, in my opinion.

Yours truly,

JOHN B. ROBERTS.

313 S. 17th St., Philadelphia, Pa.

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# ANNALS OF SURGERY

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## ORIGINAL MEMOIRS.

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### ACUTE HÆMATOGENOUS INFECTION OF THE KIDNEY.

BY FREDERIC J. COTTON, M.D.,  
OF BOSTON, MASS.

THAT the kidney may become infected by way of the blood stream is a fact long known, but it remained for Brewer<sup>1</sup> to bring to our attention a curious class of cases in which the hæmatogenous kidney infection does not imply a general pyæmic process, and to show that in certain of these infarcted infected kidneys there was no other gross septic lesion, and that the affected kidney was within reach of effective surgical attack.

With the appearance of his article, seven years ago, the infarcted septic kidney<sup>2</sup> resigned its pathological position as an exhibit, and "went surgical."

A new symptom complex, representing a definite lesion, open to attack, was presented to the surgeons.

I fear we have not taken full advantage of our opportunity. In 1908 Cobb presented an excellent series of eight cases, operated on at the Massachusetts General Hospital by

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<sup>1</sup> G. E. Brewer: ANNALS OF SURGERY, 1904, xl, 1010.

<sup>2</sup> With all respect for Brewer, it seems to me that his "acute hæmatogenous infection" is a rather formidable title for daily use. May I suggest *septic infarcted*, or *infected infarcted*, kidney as a handier handle?

himself and by certain of his colleagues, and reviewed the previous published data,<sup>3</sup> but since then the reports have been few and scattering. If we may judge by the published data of *demonstrated* cases in the hands of a few men, these cases cannot be very unusual.<sup>4</sup> They must have occurred in the practice of all of us. I confess that I have recognized no cases previous to those here reported, but as I look back I have an uneasy suspicion (amounting almost to a certainty in one case that went on to the formation of a perinephritic abscess) that I have seen such cases before, and have failed to recognize them.

Believing that I am not alone in this matter, I present the two cases here reported, intrinsically not especially notable except perhaps for the happy outcome.

They are presented for three reasons:

1. All such cases should be reported until all surgeons are on the lookout for them.

2. These cases suggest a connection between kidney prolapse and the choice (if we may so phrase it) of the localization of the lesion, that seems not to have been noted previously.

3. They are examples of what may be done by *conservative* operation if cases are operated on early enough.

CASE I.—Mrs. E. L., age thirty-nine years, married, multipara, entered Nov. 9, 1910, sent to the hospital by Dr. J. J. Fitzpatrick of Charlestown, Mass., who writes that he saw her Nov. 5, 1910. She then gave a history of an injury to her right side two years ago, the result of a fall, at a time when she was six months pregnant. There was no obvious interference with the following childbirth.

When he first saw her, she complained of irritation of the bladder and of pain in the lower abdomen and about the urethra.

Nov. 8, she complained of pain, and examination showed tenderness below the edge of the liver and over the right kidney,

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<sup>3</sup> Farrar Cobb: *ANNALS OF SURGERY*, 1908, xlviii, 680.

<sup>4</sup> Brewer, in his second article (*Surgery, Gynecology, and Obstetrics*, 1906, ii, 485), was able to cite 13 cases, personally observed.

## HÆMATOGENOUS INFECTION OF KIDNEY. 579

and there was complaint of pain also in the back, about the kidney.

Nov. 9, at 6 P.M., her temperature rose to  $103^{\circ}$  F., the pulse to 100, and she complained of chilliness and sweating, and showed marked soreness in the right flank. The urine showed a specific gravity of 1018, and albumin was present. There was diarrhœa with moderate vomiting.

Dr. Fitzpatrick referred her to the City Hospital with a diagnosis of acute nephritis, and she came to me with the admitting physician's diagnosis of appendicitis.

I saw her as an "emergency case" in the evening of Nov. 9, 1910. Physical examination was negative, except for moderate spasm of the abdomen as a whole, and tenderness over the right iliac region and in the right loin (costovertebral). The tenderness was most obvious over the appendix region, and the tenderness behind was not more than one often finds with a high appendix. The temperature was  $103^{\circ}$ , the pulse 120.

Vaginal examination showed nothing significant. There was a decided trace of albumin in the urine.

At the time I was not able to exclude an appendicitis, and consequently the first incision was made in front. Nothing abnormal was found save that the right kidney, obviously prolapsed, seemed larger than normal. The patient was turned over, and the conventional posterior kidney incision was made, and the kidney brought into view. Several whitish patches appeared, conspicuous against the background of a purple, congested, enlarged kidney. The capsule was split and reflected to either side, and a number of whitish areas stood out, dull white, outlined in purplish-black against a purple kidney. There was no pus. The white areas were obviously of embolic origin. The capsule was freely rolled back, and the infarcts cut into freely.

There seemed no reason for sacrificing the kidney, or for cutting deeper.

The rolled-back capsule was caught up (Edebohls's technic) and sutured to the muscle layers. A "cigarette" drain was left in.

There was no post-operative shock or other trouble, and four days later the records showed a temperature already fallen to normal, with a pulse of 86. The drain was still in, but there was no pus. The urine showed no albumin.

The drainage was removed on the ninth day. At no time was there any pus discharge.

Eleven days after operation the patient was "up and about," and the wound had healed solidly.

At this time the urine was of high color, slightly cloudy, specific gravity 1020, acid, very slight trace of albumin, no sugar. The sediment showed one coarse granular cast, some fine granular casts, some hyaline casts, epithelial cells (squamous only), and a few "compound granule cells."

The patient was discharged fourteen days after operation in good condition.

December 11, 1910, she entered the hospital on the gynæcological service to be treated for an incomplete spontaneous abortion. No note is made on the records of the service of any urinary complaint or renal complication, and no urine examination is recorded.

I did not see her again until February 14, 1911. At this time she had a fistulous track in the wound, which she said had developed in December. This later cleared up without any operation. At this time the urine showed no trace of albumin, and the sediment showed no renal elements. The kidney was firmly anchored, and was not abnormally tender. August 4, 1911, she reported in writing that she was well and in good condition.

CASE II.—Mrs. N. M., age thirty-four years, widow; multipara; previous health fair, though she had been overworked. For about three weeks previous to admission to the hospital she had been feeling "out of sorts," though up to a week before admission she had no definite symptoms.

During the week previous to her entrance to the hospital she had been "miserable," with abdominal pain (not sharply localized) and she had a good deal of nausea. For two days she had had sharp pain in the right lower quadrant of the abdomen, with vomiting, and had been unable to work.

The day before she entered the hospital she vomited repeatedly, suffered from general abdominal pain and tenderness, and had to have recourse to injections to move the bowels.

Her physician, Dr. T. P. Fitzgerald, of Brighton, Mass., sent her to the Boston City Hospital on December 8, 1910, on which date I first saw her. She then showed some tender-

ness of the abdomen, with involuntary spasm of the muscles of the right lower quadrant. Deep palpation with both hands showed a mass, obviously the enlarged and prolapsed right kidney, which was abnormally sensitive to pressure.

At this time the temperature was  $99.8^{\circ}$ , the pulse was 90. The white blood count showed 12,000.

The urine was turbid, of acid reaction. Albumin was present to a total between 0.125 and 0.25 per cent. There was no sugar present. No casts were found.

On December 10 the temperature was registered  $98.8^{\circ}$ , the white count 10,000. Nevertheless the pain persisted, rather more localized toward the right groin. My examination on this date showed well-marked tenderness of the right lower quadrant of the abdomen. The costovertebral tenderness in this case was present, but was not very well marked.

All things considered, however, it seemed clear that we were dealing with a renal, not with an intraperitoneal, condition, and when an operation was decided on (December 10) the loin incision was used.

The kidney was readily found, but was found in a position of well-defined prolapse. It was brought out into the wound, and showed greatly increased intracapsular tension. There were mottled whitish areas at the lower pole, but no clean-cut infarcted patches. The kidney was cyanotic, swollen, and was markedly prolapsed. The capsule was split, was rolled back, and was sutured to the muscles as in the previous case.

December 22 (the twelfth day), the temperature and pulse had fallen to normal and no albumin was present in the urine. No pain. Wound healed solidly. "Up and about" for the past four days. Discharged from the hospital.

The urine in this case showed *after* the operation: specific gravity, 1025; albumin, a trace; red blood-cells, leucocytes, squamous cells, small round epithelial cells. Apparently not as many pus-cells as before the operation. Albumin less in amount. A few days later, the analysis showed a specific gravity of 1020, a trace of albumin, leucocytes, small and large round cells, quadrate and squamous cells.

December 16, 1910: The urine was of a specific gravity of 1017, acid, with no albumin or sugar, with very few leucocytes, and very few squamous cells.

December 27: The wound was solidly healed. There was no pain, though the patient had been up and about for several days.

On March 1, 1911, this patient was seen in my office (in response to a letter of inquiry), and was found at this time in excellent condition. There had been no pain. There was no tenderness. The kidney was palpable in the position in which it had been moored, and was not abnormally sensitive to touch. A specimen of urine obtained was clear, of 1020 gravity, and without a trace of albumin. Her general health was improved and might be described as fair, though still showing under-nutrition.

Since the body of this article was written, I have chanced to observe a case that may be of value by way of contrast, a case of hæmatogenous infection associated with a frank and fatal pyæmia.

CASE III.—M. O'N., female, aged twenty-four years, married, previously healthy, was admitted to the Boston City Hospital March 20, 1911, under the diagnosis of gall-stones. She had been well until four days previous, when she began to menstruate, and (contrary to her custom) began to vomit and to have severe pains in the abdomen just below the ribs. The pain and vomiting persisted; on the second day she began to be jaundiced.

On the fourth day she entered the hospital, very sick, showing a slight jaundice, marked right hypogastric and costo-vertebral tenderness, and a slight systolic murmur over the heart.

Investigation showed, apart from the mentioned findings, a red count of 2,064,000 with a white count of 47,000. At this time she showed slight mental "fogginess." The urine showed albumin and few casts, nothing else.

Two days later the jaundice was less, the kidney tenderness was less, but the septic temperature and the septic anæmia persisted, and all means employed to check a hiccough which had developed had failed.

March 24, the local symptoms were less, the kidney evidently smaller and less obviously tender, but her condition in general was not improved.



March 27: Local signs less, but condition worse. Hiccough severe; vomiting occasional, but cannot be checked.

For 24 hours, more or less, she had been failing. At 4.30 P.M. she suddenly grew worse, and died within a few minutes in such fashion as suggested a terminal pulmonary embolism. No autopsy could be obtained.

This case showed a general sepsis. Dr. Libby (who examined her in consultation with me) found endocarditis, pericarditis, and a probable central pneumonia, beside the kidney lesion.

The case is brought up simply for contrast: it was a case of general sepsis with a kidney lesion apparently unilateral, but, owing to the generalized septic process, entirely beyond surgical reach.

The first case calls for little comment. It is typical for an early case of the type originally described, except for the complication of the floating kidney.

In the second case it may fairly be objected that no definite infarcts were found. Nevertheless, a septic infection of central origin seems clear from the clinical picture of sepsis presented, promptly and permanently relieved by relief of the extreme congestion found at operation. Engorgement alone will not account for the septic picture.

Whether such a case is a pure diffuse infection, or whether if left longer it would show localized infarctions, I do not know.

It is of interest that both cases were in "floating" kidneys, considerably displaced. In all the series so far recorded there is noted a preponderance of females over males, of multiparæ over nulliparæ, of infections of the right as against the left side.

No one seems to have noted, however, that all these differences coincide exactly with the conditions predisposing to *displacement* of the kidney.

My cases both showed definite displacement of the infected (right) kidney—how many previous cases showed the same condition is a question not to be answered from the

records. It is at least a striking coincidence, and perhaps more than that.

May there not be an explanation here of the point that has puzzled all the writers on this subject, namely, why the kidney (and the kidney only) should be the picked site of localization for an infection that must primarily have been a general blood infection?

If I am right in this surmise, then the operation done in these two instances represents an improvement in technic (in the earlier cases at least), for it must not only relieve tension and provide drainage, but must also relieve the abnormal position which is a cause of poor circulation and of abnormal intracapsular tension.

The recorded series of cases is too short to warrant any very positive conclusions, but it does seem undesirable to sacrifice a kidney because *part* of its substance is gone, if we can by any safe means save the rest of it.

In the later and severer cases the kidney may be past saving. In the earlier and simpler, and in the doubtful cases, it seems to me worth while to try and save what we can. Nephrectomy is easy and can be done later, if need be.

May it not be wise, in the doubtful cases at least, to try the measures of wide decapsulation, suspension, and drainage, that worked out so fortunately in the two instances here noted?

# MALIGNANT PAPILLARY ADENOMA OF THE KIDNEY.\*

BY J. BENTLEY SQUIER, M.D.,  
OF NEW YORK.

THE large variety of renal tumors which have been histologically differentiated is evidenced in Küster's classification. Including those of the kidney proper, the capsule, and the adrenal, twenty-six distinct types are mentioned. Among these, malignant papillary adenoma is of sufficient rarity to justify the presentation of this patient and kidney specimen.

In a series of 529 cases of renal tumors, Albarran and Imbert found only thirteen malignant adenomata. Eisenstaedt, after a careful search of the literature, found one absolutely proven case, that of Sudeck in 1892, in addition to the one reported by him.

The history of the case which I desire to report is as follows:

The patient, a carpenter, forty-three years of age, appeared at my clinic March 9, 1911.

On December 1, 1910, while lifting a heavy weight, he was seized with severe pain in the left inguinal region, which radiated to the left lumbar region. A desire to urinate was present, and upon voiding, blood in large amount was noticed. For one week he was confined to his bed. During this time, the pain continued, he vomited frequently, and the hæmaturia slowly disappeared. At the end of the week, all symptoms had cleared up, and one week later he went back to work.

He was then without symptoms until February 1, 1911, when, on lifting a heavy weight, the symptoms returned. During this attack, several finger-like clots of blood were voided. The passing of the clots caused severe tenesmus. The duration of the attack was six days.

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\* Read before the American Association of Genito-Urinary Surgeons, June 2, 1911.

When he appeared at the clinic, he had had no symptoms for four weeks, with the exception of an occasional sensation of weakness in the left lumbar region. His past history was negative, except for some irregular gastro-intestinal symptoms extending over a period of years; such as flatulence, sense of weight in epigastrium, and constipation. He had always been a hard working man, and did not remember ever having had serious illness. His mother had died of some form of cancer.

*Physical Examination.*—Medium frame, fairly well nourished, skin and mucous membrane good color, no adenopathy, chest normal, abdomen negative, kidneys not palpable. Rectal examination negative. Cystoscopy showed a normal bladder, prostate, and ureteral orifices. Ureteral catheterization collected normal urine from either kidney. Radiographic examination of kidneys did not aid diagnosis.

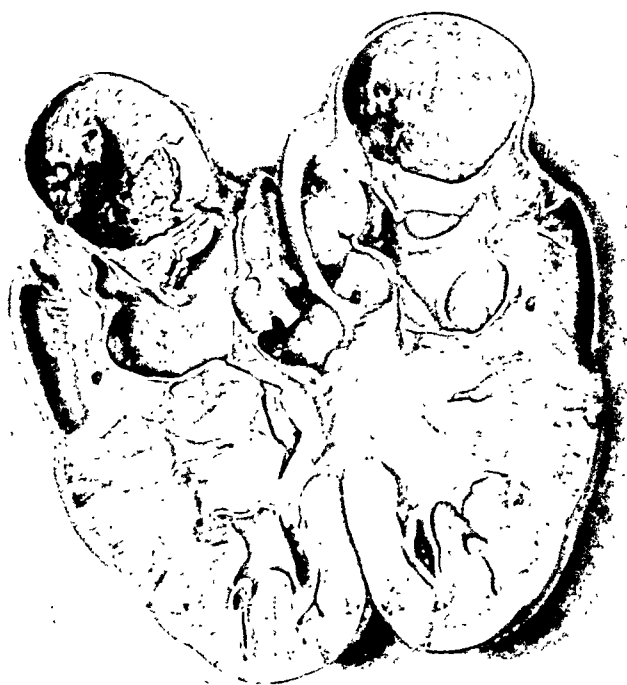
In view of these negative findings, the patient was sent home to be observed by his family physician. On March 18, a recurrence of the hæmaturia took place lasting two days. He was admitted to the hospital on March 21, and upon the following day, left nephrectomy was performed through a vertical lumbar incision. There were many adhesions about the upper lobe of the kidney. The wound was closed about a rubber tissue drain.

Convalescence from the operation was uneventful; the drain was removed at the end of 48 hours; the wound healed by first intention. He was out of bed at the end of a week, and left the hospital on April 3.

*Pathological Examination.*—Specimen: Kidney examined after fixation in formalin and opened by a longitudinal median section. At one pole there is a globular cystic cavity whose wall, in the hardened state, has a yellowish color, being thin over that portion of its extent which projects beyond the kidney parenchyma. The exposed portion of the wall of the cavity measures between 2 to 3 mm. in thickness, and the cavity is filled with yellowish granular material. Where the cyst is imbedded in the kidney substance, a soft, friable, narrow layer of grayish tissue separates it from the pelvis which is dilated at that point (Figs. 1 and 2).

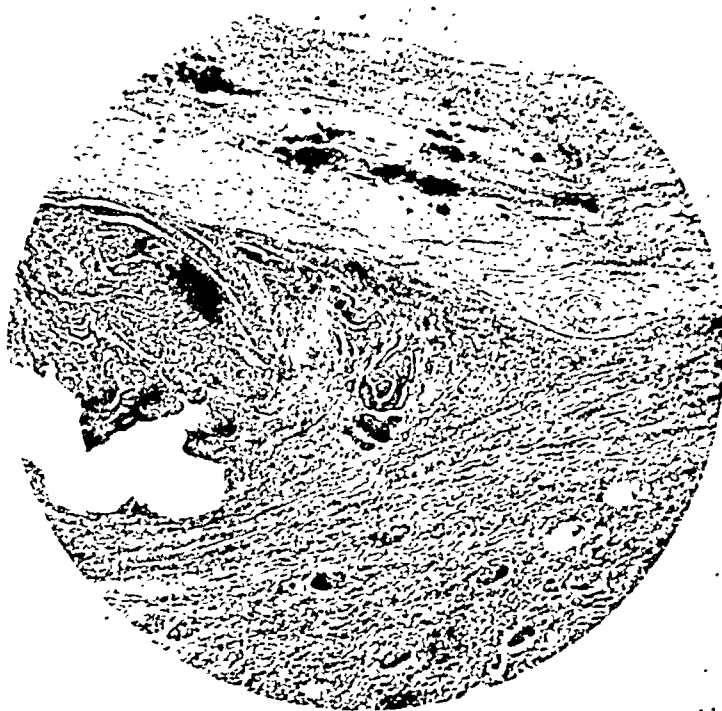
Section A: Sections, including that portion of the wall of the cyst which is imbedded in the parenchyma of the kidney, present the following picture: The cyst wall is made up of a zone of connective tissue with numerous areas of lime deposit. The kidney parenchyma is bounded by this layer, except at one point where there is a tumor tissue just outside of the cyst wall, between the kidney tissue and the fibrous

FIG. 1.



Malignant papillary adenoma of kidney.

FIG. 3.



Low power microphotograph of Section A, showing normal kidney and cyst wall with tumor tissue between.

FIG. 4.



Low power microphotograph of tumor tissue.

FIG. 5.



High power microphotograph of tumor tissue.

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membrane just described. Attached to and partly separated from the inner aspect of the cyst wall is some necrotic material, including slits that doubtless were filled with cholesterin crystals. These crystals must have been imbedded in a degenerate cyst content, the nature of which cannot be definitely ascertained, but which probably represents broken down tumor tissue, in view of the fact that the shadows of cells can be distinguished. At a point corresponding to those areas of the gross specimen which presented the yellowish material previously mentioned, there is a layer of papillary adenoma in which the proliferative phenomena, multiplication of cells, and formation of solid nests are sufficiently well marked to warrant a diagnosis of malignant adenoma. For the

FIG. 2.

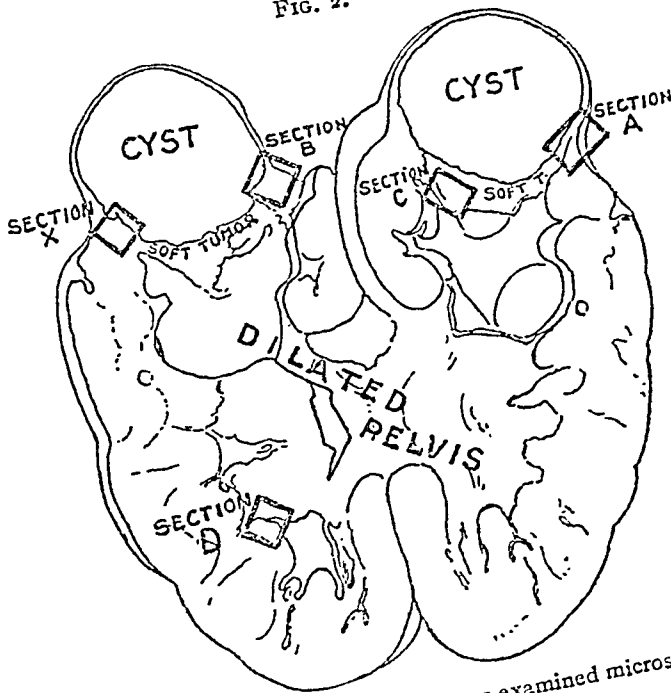


Diagram showing locations of sections examined microscopically.

most part in this area there are slender, tuft-like outgrowths, covered with cuboidal and polygenal cells, communicating and fusing with solid masses in a manner characteristic of those adenomata that show a transition into a medullary type. In the area outside of the cyst and next to the kidney parenchyma there is a similar papillary tumor. The kidney tissue itself at this point shows marked atrophy, foci of round-celled infiltration, and degeneration of glomeruli (Figs. 3, 4 and 5).

Section B: Another section taken from the border of the cyst shows only a minute area of papillary tumor in the fibrous wall itself. Section C: Sections made from the soft tissue just outside of the cyst wall show papillary adenoma undergoing marked degeneration. In this specimen where the papillary outgrowths are not so crowded the cells take on a high cylindrical form.

Section D: A piece of the wall of the pelvis of the kidney shows moderate thickening, due in part to a submucous inflammatory process and oedema.

*Diagnosis.*—Cystic tumor of the kidney, in the wall and outside of which is a papillary malignant adenoma. Owing to the dense fibrous nature of the cyst wall, with its calcareous inclusions, it must be assumed that the cyst is the older lesion; that it may originally have harbored a benign papillary adenoma which has since become malignant (malignant adenoma), and is invading both the fibrous tissue wall of the cyst and the parenchyma of the kidney.

Since leaving the hospital and returning to work, there has been a continuance of the gastro-intestinal symptoms.

Considering the possibility of metastasis in the stomach, a series of X-ray plates were made of the stomach on May 25. The findings were as follows:

Stomach is of the cowhorn type. Size: Normal.

Position: Slightly prolapsed, the greater curvature being on a level with the umbilicus, the pylorus  $1\frac{1}{2}$  in. above and to the right of the umbilicus.

Peristalsis: Of the 4-wave type, moderately active and equal in greater and lesser curvatures, not interfered with by adhesions or new growth of the wall of the stomach.

The first portion of the duodenum, which usually appears as a triangular cap, has more the appearance of a brass button on a steer's horn when the stomach is of this type. This triangular cap or button is separated from the pyloric end of the stomach by a space  $\frac{3}{16}$  of an inch, which indicates the normal pyloric sphincter.

*Diagnosis.*—From a study of these plates, one is justified in stating that the stomach is of the size, shape, and position as described in the findings, moderately active, motor phenomena of the 4-wave type, with no evidence of new growth of or pressing on the stomach.

*Conclusion.*—The malignant papillary adenoma was probably primary in the kidney and localized.



# POLYP OF URINARY BLADDER IN A THIRTEEN MONTHS OLD CHILD.

WITH A REVIEW OF THE LITERATURE.

BY IRVIN S. KOLL, M.D.,  
OF CHICAGO.

THE rarity of vesical tumors in young children makes the subject one of the most interesting in genito-urinary surgery. Not only is the interest from a surgical and clinical aspect, but also from the pathological picture, which is quite varied. Mandelbaum<sup>1</sup> conveniently classifies neoplasms of the bladder according to their origin: (1) epithelial tissue group: papilloma, adenoma, carcinoma, cysts, polyps; (2) connective-tissue group: fibroma, myxoma, sarcoma; (3) muscle tissue group: myoma.

This division is more or less used with some variation in many of the pathological reports reviewed, covering the past twenty-eight years of literature.

In 300 cases of bladder tumor which came to operation, Von Frisch<sup>2</sup> reports only three in children—nine, eleven and thirteen years of age. All three of them were papillomata. Davis's<sup>3</sup> youngest patient was sixteen years of age, in thirty-seven cases operated. Rumpel<sup>4</sup> reports a case of myxofibroma in a male, three years of age, successfully operated, with no recurrence at the end of six months. Steffen<sup>5</sup> has compiled thirty-one cases, covering a period of twenty-two years. Most of the specimens were obtained at autopsy. All of the thirty-one cases died. Twenty-one were sarcomata, one papilloma, nine myxoma. Fifteen of the cases were in males, sixteen in females. The average age was five years; the youngest eleven months (sarcoma), the oldest twelve.

Hüsler<sup>6</sup> cites fourteen cases collected by Steinmetz, from the European clinics, from 1893 to 1905. The average age was five and one-half years; the youngest one and one-half,

the oldest twelve. Ten of the fourteen occurred in males. Seven of the tumors were benign, seven malignant. Of the benign he gives the following mixed classification: 2 fibroma-œdematosum, 1 fibrorhabdomyoma, 1 myxorhabdomyoma, 1 myxoma, 1 papilloma. The seven malignant tumors were all sarcomata.

Half of the number submitted to operation. Of these only three recovered; one had a recurrence one and a half years later, with fatal issue.

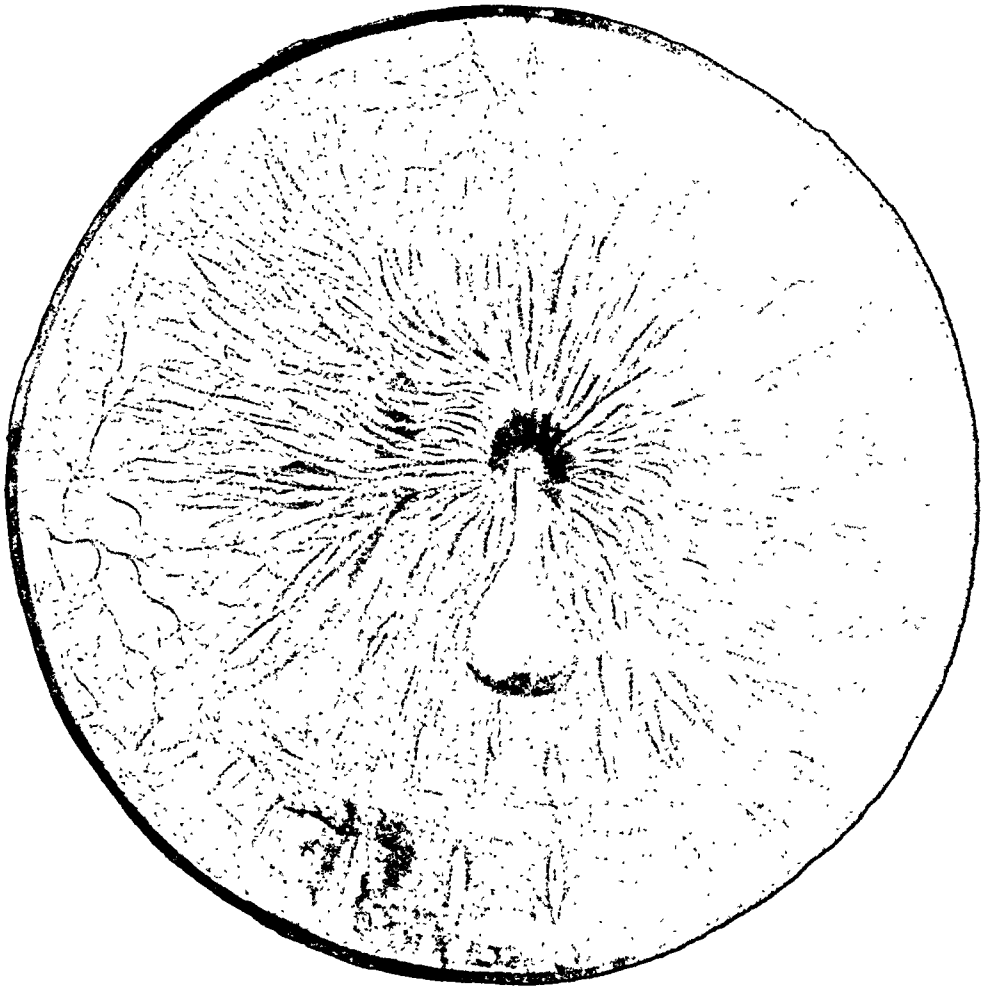
Clinically, the manifestations are more or less similar in all the cases. Two of Hüsler's cases, briefly cited, are as follows:

Male, one and one-half years; normal delivery. When four months of age mother on one occasion noticed a few drops of blood at end of urination. There followed a gradually increasing painful and difficult urination. An œdema and swelling of the external genitals developed; then suddenly complete retention, with a rapidly succeeding uræmia, and death. At autopsy an œdematous tumor mass, the size of a small apple, was found apparently springing from the urethral mucosa.

The second case was a male, seven years of age, whose mother, six months prior to his entrance to hospital, noted that it took the child a long time to urinate, and that the urine came away in dribbles. Later the patient began complaining of a sticking pain and burning when passing his water. This increased, when suddenly there was complete retention. Only once a small amount of blood was seen. A soft rubber catheter introduced into the urethra encountered a slight resistance at the entrance to the bladder. Per rectum under anæsthesia, a movable mass was palpated in the fundus of the bladder, which was about the size of a plum. Operation was refused. Obstipation developed; sudden perforation of bladder into rectum. Exitus. Autopsy showed a tumor of the size described obstructing the right ureteral orifice and extending up into the fundus. Microscopic diagnosis was myxoma-papillare.

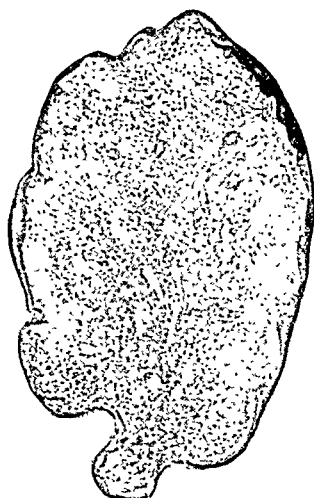
The writer's case was sent to him by Dr. Lester E. Frankenthal, who had seen the patient in consultation with Dr. H. H. Frothingham. The mother gave the following history: From birth, which was instrumental, the patient, now thirteen months old, has been in perfect health up to one week before entrance into Michael Reese Hospital. At this time the mother noted that the child had not urinated for some hours and was crying, evidently from pain. On looking at his abdomen, she thought it appeared distended, and then sent for Dr. Frothingham, who

FIG. 1.



Polyp attached to internal urethral orifice.

FIG. 2.



Outline of tumor. Section through pedicle.  $\times 20$ .

FIG. 3.



Structure of tumor.  $\times 103$ .

catheterized the patient and obtained a large quantity of turbid urine. For a short time the child urinated small quantities, then again there was complete retention.

When I first saw the patient he was in great pain, the fundus of his bladder reaching as high as his umbilicus. There was a marked phimosis, with a very long prepuce. Catheterization yielded 360 c.c. of slightly turbid urine which, upon examination, showed a great many leucocytes, no blood and, culturally, a pure strain of colon bacillus. Upon passing the catheter a distinct obstruction was encountered at the internal urethral orifice, which, however, promptly allowed the catheter to pass into the bladder.

Cystoscopic examination showed only a slightly inflamed mucosa, no calculi and no neoplasm was seen. At no time was there any hæmaturia.

Circumcision and permanent catheter for forty-eight hours did not relieve the retention. At intervals it was noted that the patient would urinate a few drops, then suddenly stop, and he would use a great deal of abdominal muscular force in the vain attempt to empty his bladder. Rectal examination was negative. Careful exploration with a sound again encountered the resistance at the internal urethral orifice. The diagnosis of obstruction due either to some congenital malformation or a new growth was made, and consent for an operation was obtained.

The typical suprapubic incision was made. When stripping back the peritoneum a marked hypertrophy of the musculature of the bladder was very evident, and the bladder itself was about three times its normal size. As soon as the bladder was incised and the walls retracted, a tumor mass was seen, about the size of a small hazelnut, lying just below the internal urethral orifice (Fig. 1). This was smooth, had two lobules, and was attached by a pedicle, about 2 cm. in length, which sprang from the mucosa lining the posterior wall of the urethral orifice. This relation explains how it was that the patient could at times pass a small amount of urine, then have a sudden stoppage—a typical ball-valve action. The connection to the urethral mucosa also explains why the tumor could not be seen with the small cystoscope, but probably would have been visible had it been in an adult.

The growth was grasped in a pair of forceps and twisted

off its pedicle, this procedure being considered preferable to having any ligature material lying in such an undesirable position. There was no bleeding from the stump. The bladder was closed completely with two rows of running plain catgut. A very small fistula developed on the fifth day, which very promptly closed, the wound healing by primary union. Spontaneous urination took place immediately following the operation, and the convalescence has been uninterrupted.

The pathological report is that of a simple polyp, covered by a layer of stratified squamous epithelium, continuous with that of the mucosa of the urethral orifice and bladder. Magnification twenty times shows the outline of the tumor, with section through the pedicle (Fig. 2). Magnification 103 shows the structure of the tumor under a higher power (Fig. 3).

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- <sup>3</sup>Lincoln Davis: Primary Tumors of the Urinary Bladder, ANNALS OF SURGERY, Phila., 1906, xliii, p. 556.
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- <sup>7</sup>Guizy: Trois Cas de Tumeurs de la Vessie sans Hematurie, Ann. d. Mal. des Org. Gen.-Urin., 1907, xxv, p. 103.

# INTRAPERITONEAL OPERATION FOR EXTENSIVE CARCINOMA OF THE BLADDER WITH NEW METHOD OF TREATING THE DIVIDED URETER.

BY PAUL M. PILCHER, M.D.,  
OF BROOKLYN, NEW YORK.

THE following case came to our private hospital for treatment through the courtesy of Dr. John W. Poole, of Brooklyn:

**CASE REPORT.**—A woman, sixty-two years of age. Family and previous history negative. Her first intimation that anything was wrong was the appearance of a small amount of blood in the urine ten months before consulting us. This means that the bladder involvement had already reached some advancement at that time. Blood continued to be passed in the urine at intervals, with some periods when no trace of blood could be found. Laterly the amount of blood in the urine has greatly increased, although it is absent at times. There was only occasional increased frequency of urination. Lost considerable weight, but still an obese, thick-set woman. No symptoms referable to either kidney.

**Cystoscopy.**—Right ureter opening (ostium) normal. Right kidney function normal, as shown by the phenolsulphonephthalein test (12 minutes).

Left ureter opening swollen and distorted, and seen to be involved in a carcinomatous growth. The opening itself was crater like, being surrounded by a raised up cauliflower growth.

The left ureter opening, the left wall of the bladder, a portion of the trigone, some of the anterior wall, and an area extending around the urethral orifice were seen to be involved in the malignant growth.

A vaginal examination revealed a distinct, hard mass occupying the vesicovaginal septum, about two inches in length by one inch in width. It did not involve the vaginal mucous membrane. Every one will recognize the extent of the lesion which was to be dealt with.

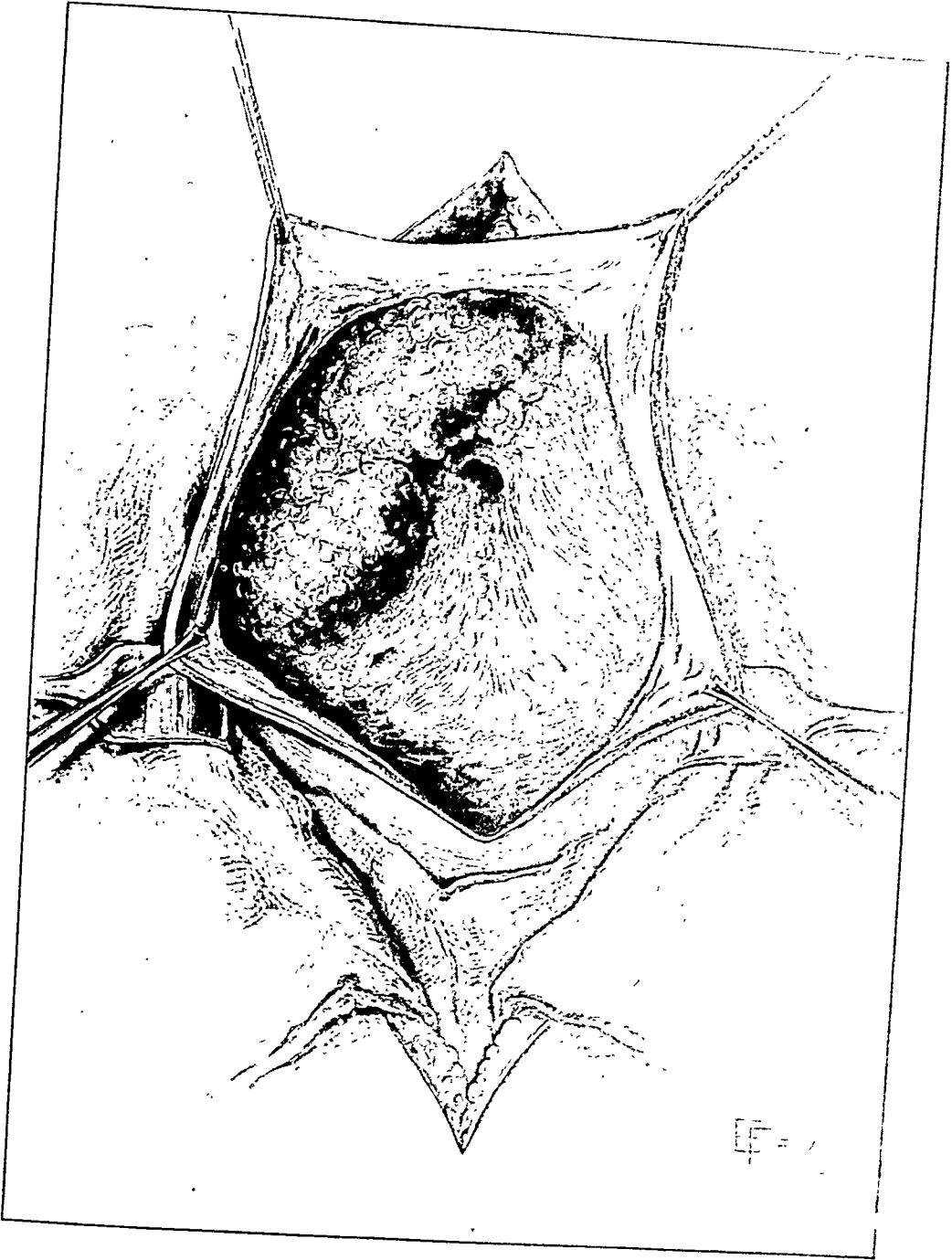
Operation, April 21, 1911, by the writer, assisted by Dr.

Lewis S. Pilcher and Dr. James T. Pilcher. Incision from umbilicus to symphysis; peritoneal cavity opened; Trendelenburg posture; pelvis emptied of intestines and protected by gauze pads; bladder widely opened in the median line and growth well exposed. Using scissors, the bladder wall which was involved was detached from the healthy bladder wall down to the urethral opening and the left ureter opening. At the point of exit of the left ureter it was found that the growth was superficial, having extended along the mucous membrane without involving the deeper structures. It had not apparently extended into the lumen of the ureter. The mucous membrane, the submucous structures, and a portion of the muscular tissue surrounding and underlying the left ureter opening including all of the tissues involved in the malignant growth, were freed and dissected up, the ureter itself not being cut across. By using traction on the flap which had been separated it was found that the ureter was loosened from its sheath within the bladder wall and could easily be pulled down through the bladder wall. In this particular case over two inches of normal ureter were drawn through the bladder wall into the interior of the bladder. The question of what should be done with the ureter was next to be solved. It occurred to me that a great deal of time would be saved and danger avoided, if, instead of transplanting the ureter, the ureter should be cut across *in situ*, about an inch from its ostium, and simply be allowed to slip back into place. This was done, the lumen cut across and the end split up about one-quarter of an inch to avoid narrowing the outlet by cicatricial contraction.

My theory was this: Having removed the lower inch of ureter and a portion of the interior of the bladder there would remain an interval of from one-half to three-quarters of an inch between the cut end of the ureter and the interior of the bladder. The bladder musculature having been injured, and the bladder being kept empty for three or four days, would offer very little resistance to the efflux of urine from the ureter along the avenue of least resistance, the course of the ureter through the bladder wall being changed from an oblique one to a much shorter and more direct one. Experience with ureterovaginal, uretero-abdominal, and other ureteral fistulas has taught that if we have an unobstructed ureter, then a shell of other tissue forming a sinus and then a surface lined with mucous membrane, and no other outlet for the



FIG. 1.



An extensive growth is shown after opening the abdomen, racking off the pelvic viscera with gauze and freely opening the bladder by a vertical incision, including the anterior and superior surfaces of the bladder. It will be noticed that the growth involves the left side of the bladder, more superficially the ostium of the left ureter opening and the first portion of the urethra. This growth also involves the vaginal septum, but not the mucous membrane of the vagina.

FIG. 2.



Fig. 2 shows the area of the bladder which was removed at operation, including the entire growth, most of the left lateral portion and inferior portion of the bladder, the left ureter opening and a portion of the urethra. The area above the left ureter opening has been dissected up. Here the growth was superficial. In raising up this portion of the bladder wall, including the opening of the left ureter, it was noticed that the ureter itself was pulled through the bladder wall, and about two inches of the lower end of the ureter extended into the wound, free from carcinoma. Instead of transplanting the ureter, it was cut across as indicated in the drawing by a transverse and vertical line about an inch from its ostium, and the severed end of the ureter was allowed to slip back into place, after the end had been slit up about one-quarter of an inch to avoid narrowing of the outlet. There remained then an interval of one-half inch between the cut end of the ureter and the interior of the bladder, and a ureterovesical fistula was established.

urine from the ureter, the establishment of a fistula along this avenue is absolutely certain. I made use of this knowledge in the present case and intentionally formed an *ureterovesical fistula*.

After all the cancerous tissue had been removed, including much of the surrounding tissues beneath the symphysis, a portion of the anterior vaginal vault and all but a section of the urethral orifice, the bladder was reconstructed. The vesicovaginal opening was not closed and a rubber drainage tube was led through it from the bladder to the vagina. The anterior and lateral walls were brought together first by a running Connell suture of catgut and reinforced by a running Lembert suture of catgut. The intraperitoneal portion of the bladder was closed by a separate suture and reinforced a la Mayo. The peritoneal cavity was closed without drainage. The suprapubic portion of the wound was closed with the exception of a cigarette drain behind the symphysis. A second drain of rubber tubing was brought out beneath the symphysis and to the left of the labium majus. The bladder had in this way been entirely closed excepting at its base in the region of the trigone and to the left of the urethral orifice, which could not be entirely covered in but which was satisfactorily drained by the tube in the vagina. The left kidney discharged its urine via the left ureter, then through the ureterovesical fistula into the bladder.

The patient made an uneventful operative recovery. There was no leakage of urine excepting through the vesicovaginal opening. The drainage tube was removed from beneath the symphysis on the third day; from the suprapubic opening on the fourth day; the vesicovaginal tube on the fifth day. At no time was there any symptom referable to the left kidney. She passed urine *per urethram* on the tenth day. The leakage *per vaginam* ceased about the sixteenth day. She left the hospital on the thirty-first day, completely recovered.

I appreciate that the first criticism which would be offered would be that the bladder musculature would contract and stenosis around the vesical orifice of the fistula take place. Our experience, however, in cases of prostatectomy in which a comparatively large section of the prostatic urethra has been entirely removed without the development of any obstructive

stricture at the vesical outlet led me to hope that a similar process would protect the ureterovesical opening.

The experience gained in this case has led me to theorize as to the possibilities of attacking the lower end of the ureter through the bladder, not simply to remove calculi, as has been so frequently done, but in the treatment of strictures of congenital origin or any disease involving the lower end of the ureter which does not involve the peritoneum. It is essential to my mind that the peritoneum should be intact, for, even if a relatively large portion of the ureter were removed or stripped out from its peritoneal covering, the tunnel thus left would suffice to convey the urine to the bladder and form an ureterovesical fistula. Knowing how difficult it is, oftentimes, to cure an ureteral or a vesical fistula of accidental origin, I think we would be justified in taking the chance of the fistula remaining patent. I believe that the chances of this are just as good, and not attended by so many chances of failure, as in ureteral transplantation in the hands of the majority of surgeons. In the only case of transplanted ureter which has come under my observation, post-operatively, I found that no urine was entering the bladder from the corresponding kidney.

# SPLENECTOMY FOR RUPTURE OF SPLEEN.\*

WITH REPORT OF FOUR CASES.

BY JOHN C. McCOY, M.D.,  
OF PATERSON, N. J.

SPLENECTOMY is indicated in certain pathological conditions affecting the spleen causing an enlargement of the organ, interfering with the health of the individual, or for the reason that an enlarged spleen is a source of danger to the patient, owing to its susceptibility to laceration from trauma or even rupture without external violence.

The hypertrophy may be due to various pathological changes in the spleen substance, or the enlargement may be the result of systemic or infectious processes. Among the former causes may be mentioned: tumor of the spleen due to cysts, parasitic and non-parasitic; malignant growths, usually sarcoma, either primary or secondary; benign growths; abscess of the spleen, and contusion. No well-authenticated case of primary carcinoma is recorded.

Of the systemic and infectious conditions giving rise to enlargement of the spleen are malarial and syphilitic spleen; amyloid spleen; hypertrophy of the spleen with cirrhosis of the liver, and tubercular spleen. It has been generally accepted that tuberculosis of the spleen never occurs as an independent condition, but is usually secondary to a general tuberculous process, and in itself is of very little clinical importance. So far as a differential diagnosis between a tuberculous enlargement of the spleen and a hypertrophied spleen from other pathological conditions is concerned, I believe the differentiation would be impossible in the absence of tubercular symptoms in other organs. That it is possible to have a tubercular condition present in the spleen with no apparent tubercular process elsewhere in the body, is illustrated in one of my cases.

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\* Read before the New Jersey State Medical Society, June 15, 1911.

The spleen may be classed as one of the blood-producing organs, and probably takes an active part in disposing of the broken-down blood-cells. How far it may exert an inhibiting effect, acting in the capacity of a mechanical filter, upon organisms entering the circulation, we cannot say. It has been claimed that patients from whom the spleen has been removed are more susceptible to infection. In no cases reported, however, has the removal of the spleen been followed by conditions which could be attributed to its absence. As to the effect upon the economy the extirpation of the spleen has, it is hard to say. It would seem that in those cases in which there were no marked pathological changes in the organ, there is no detrimental effect in the individual as the result of the removal of the spleen.

In two of my cases of extirpation following traumatism of the spleen, which have been carefully followed since operation, in the one case for a period of 16 months and in the other for 7 months, the general condition of the patients seems to have remained as good as it was prior to the loss of the organ. Both patients have steadily gained in weight, are able to indulge in athletic sports, and show no evidence of fatigue, even under severe exertion. Blood examination demonstrated a practically normal condition, 16 and 17 months respectively after splenectomy. It has been noticed in both cases, that though there has been a steady gain in flesh, and an excellent capillary circulation, giving an almost florid complexion, there is a faint but evident underlying bronze hue to the skin over the entire body, resembling the early stage of hæmatogenous jaundice of pernicious anæmia. Could this be explained on the basis of the absence of the spleen, which prior to its removal had disposed of the broken-down cell elements of the blood? We know from animal experimentation, and observations upon the human subject, following the removal of the spleen, that its presence is not essential to life; neither does its extirpation seem to interfere with the physical well being of the individual.

As to how far other parts of the economy, such as the

bone-marrow or lymphoid tissues, take on increased activity after removal of the spleen, is not definitely known. There has been observed in some instances, after splenectomy, a general enlargement of the lymphatics and enlargement of the thyroid. We know that during fetal life, the spleen forms red blood-cells, this function being probably stopped at birth. It has been stated that the bone-marrow assumes increased activity upon removal of the spleen and compensates for its absence.

In cases of rupture of the spleen, in which extirpation has been done, the observations and subsequent blood examinations would seem to show that the changes in the blood elements were more marked and permanent than would be expected from the simple loss of blood. From our own investigations, it would seem to be only a question of time, when the blood constituents again reach a normal state.

Certain changes in the blood appear to be constant following splenectomy: (1) an increase in the number of white blood-cells; (2) a diminution in the number of red-cells; (3) an increase in the number of eosinophiles; (4) a disproportionate and more persistent diminution in the hæmoglobin.

Cases of rupture of the spleen are not common, 160 cases having been reported up to 1908. A large percentage of ruptures have occurred in pathological spleens, mostly in spleens enlarged from malarial or infectious conditions.

During the past three years, I have seen four cases of rupture of the spleen, two of which could be attributed to direct violence. The spleen was removed in each instance with one fatal result, that of the gunshot case.

The first case was one of gunshot wound of spleen. Case II was one of contusion of an apparently normal spleen, with subsequent rupture. Case III was one of contusion of a malarial spleen, with subsequent rupture. Case IV was a spontaneous rupture of a tubercular spleen with absolutely no history of trauma, appearing in a patient while in bed asleep.

CASE I.—Mrs. M., age thirty-eight. Seen in consultation with Dr. George Fisher. During a period of mental depression, placed a 32-calibre revolver against the left hypochondriac region and discharged the ball into the abdomen.

*Physical Examination.*—Large robust woman, married. Heart and lungs normal. Very fat abdominal wall. Pelvic examination negative. Perforating wound just below the free border of the ribs on left side three inches to the left of the ensiform cartilage, skin surrounding wound showing powder marks. Perforating wound just below border of ribs in anterior axillary line of left side, evidently point of exit of bullet. Abdominal wall rigid on right side and sensitive to pressure over left hypochondriac region; most marked just between the ribs. Temperature 98°; pulse 90, and there was nothing apparently alarming about her condition.

During the next 48 hours, the abdominal rigidity became more marked, distention more pronounced. There was evidence of general peritonitis. At end of 48 hours, temperature 102°, pulse 120; vomiting. Urinalysis negative.

*Operation.*—Median incision, free blood in peritoneal cavity, general peritonitis, rupture of the spleen, bullet having passed directly through the organ. Splenectomy. Death in 36 hours.

PATHOLOGICAL REPORT BY DR. F. R. SANDT.

The organ was but slightly increased in size, it was firm to the touch, the capsule was normal, the surface smooth, and the edges sharp. One portion of the organ, about one-fifth of it, was completely detached by the passage of a bullet and the rupturing effects of the resulting hemorrhage. Microscopical sections gave no pathological changes except in area close to injury, where there was an extensive hemorrhagic infiltration of the splenic tissue.

As stated, it has been claimed that tuberculous enlargement of the spleen *per se* does not occur. Dr. W. J. Mayo in 1909 reported a case of splenic tuberculosis, in which, other than the enlarged spleen, the physical examinations were negative. I wish to add the following case of splenic tuberculosis terminating in spontaneous rupture of the organ, occurring in a woman, who up to the time of the rupture of the spleen had been in her usual health, and showed no evidence of tubercular infection after the removal of the spleen.



CASE II.—I am indebted to Dr. Rush Neer, with whom I saw the case in consultation, who had the case under observation for two days before admission to the hospital, for the following statement: "Patient went to bed Feb. 7, 1909, feeling perfectly well. About 4 or 5 A.M., Feb. 8, awoke suddenly with severe abdominal pain. When seen by me, the abdomen was distended, dulness on both sides, especially painful over left curvature of the colon. Purgatives administered and hot stupes applied to the abdomen.

"Feb. 9, several evacuations of the bowels, less abdominal distention, less pain. Vomited. Temperature 99.6°; pulse, 104.

"Feb. 10, temperature 99°; pulse 120. Severe abdominal pain, more distention."

Seen in consultation with Dr. Neer, Feb. 10, 2 P.M. Entered hospital, 4 P.M.

Mrs. F., German, age sixty-seven, married 38 years, two children. States that five or six months ago was conscious of slight pain in the left side, particularly upon exertion; also noticed a more frequent desire to urinate. Other than the frequent urination and slight pain in left hypochondriac region, previous personal and family history negative. During the past two months, the frequency of urination has been more troublesome. Always constipated. Ceased menstruating at 47.

*Examination.*—Well nourished, very anæmic, skin bronze-like hue, conjunctiva jaundiced, facial expression anxious. Tongue thickly coated and dry. Heart and lungs normal. No enlargement of the lymphatics.

Abdomen: Prominence of the left side, extending from free border of ribs to pelvis. Palpation showed a more or less irregular mass, rather boggy in this area. Dulness extended from near the centre of the abdomen to the posterior axillary line. Pain on pressure was most pronounced over the region of the left kidney. Pelvis negative. Temperature 99°; pulse 102; respiration 36.

During the next 24 hours there was an almost constant desire to urinate, patient passing 22 ounces of urine in this time. Urine showed albumin, pus, and casts.

Feb. 10 to 12: Temperature ranged from 99° to 101°, less pain in abdomen, but prominence more pronounced. Amount of urine for 24 hours did not exceed 26 ounces. Urine continued to show blood and pus.

Feb. 14: Cystoscopic examination showed evidence of chronic cystitis. Ureteral catheter introduced into the left ureter and left *in situ* six hours. Diagnosis of pus kidney made, and operation advised, but refused by family.

Feb. 14 and 18: Patient's condition seemed to improve, began to take light food, and bowels moved daily. Less abdominal pain, and diminution of abdominal distention. The mass diminished in size, extending to within two inches of the umbilicus and to within three inches of iliac crest. Extremely tender over entire left side. Rigidity of right rectus. There continued to be frequent desire to urinate, which seemed to be relieved when patient was placed in semireclining position. The low 24 hours' urine persisted, varying from 18 to 24 ounces; each examination showing blood and pus.

On the morning of Feb. 19, patient had a severe chill, lasting 15 minutes, followed by a rise of temperature to  $102.4^{\circ}$ , pulse 128. Tumor in left side more prominent and distention more pronounced. Pain excruciating.

Operation at 1 P.M., Feb. 19. Longitudinal incision in lumbar region from ribs to ilium. When kidney was reached, it was found about one-third larger than normal, surface apparently normal. Large intraperitoneal hæmatoma presented. Peritoneum opened, when there was evacuated three or four quarts of chocolate-colored blood and clots. When cavity was cleansed, there presented an enlarged spleen having several lacerations of its capsule, upon its upper surface. An incision extending inward from the upper extremity of the original cut was made, giving freer access to the spleen. Spleen was then turned over. Splenic vessels clamped and ligated and spleen removed. Patient's condition was serious; 1200 c.c. normal salt solution given intravenously.

Two days after the operation, the temperature was  $99^{\circ}$ ; pulse 86. From this time convalescence was uneventful, the patient leaving the hospital on the thirty-fifth day after operation. The maximum temperature during convalescence was  $99.4^{\circ}$  and maximum pulse 98. The maximum amount of urine passed in any 24 hours during this period was 41 ounces.

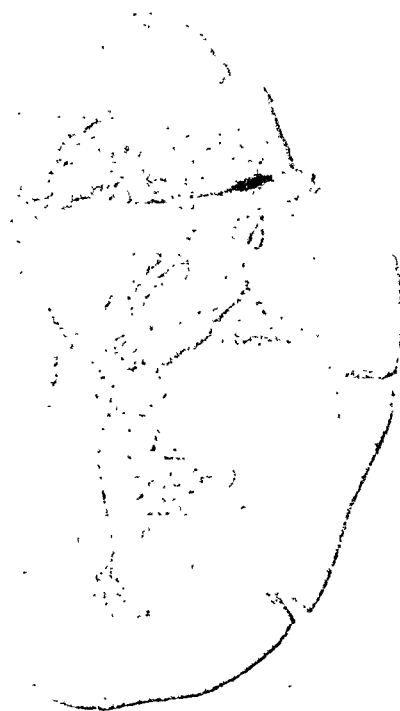
The patient remained in fairly good health for 11 months after leaving the hospital, when she died, from what the attending physician designated as pneumonia. It would seem fair to pre-

FIG. 1.



Contusion of apparently normal spleen; subsequent rupture (Case II).

FIG. 2.



Contusion of malarial spleen, intracapsular hemorrhage, rupture (Case III).

FIG. 3.



Tuberculous spleen; spontaneous rupture (Case IV).



sume that the cause of death was probably pulmonary tuberculosis. It is also probable that the lesion in the left kidney was tubercular. The peritoneum and intestines exposed appeared normal.

The pathological report of the spleen, signed by Dr. F. R. Sandt, is as follows:

*Specimen of a Spleen.*—Case of Mrs. F. The organ measured 25 cm. in length and 16.5 cm. in width. Weight 450 Gms. The specimen was uniformly enlarged and the surface smooth. To the touch there was a doughy feeling as if a cystic condition existed. The capsule was thin and stripped easily; three ruptures of the capsule through which the splenic pulp protruded were noted. A longitudinal section of the organ showed a firm periphery, but the central portion was partially destroyed and converted into a number of small irregular communicating cavities, the walls of which were composed of the fibrous tissue of the spleen or the trabecula. Microscopic sections from the periphery gave the picture of an acute splenitis. The capsule was thin, no trabecula and Malpighian corpuscles were visible. The cells were closely packed together, and four types of cellular elements were found. First, the cells of the splenic pulp, large granular elements similar to the large mononuclear cells of the blood; second, small lymphocytes; third, narrow sickle-shaped cells; and fourth, polymorphonuclear leucocytes. A fatty degeneration of some of these cellular elements was noted. Sections from the deeper portions show a number of imperfectly formed and degenerating tubercles. Numerous giant-cells were noted. These tubercular processes were surrounded by densely packed lymphocytes. Tubercle bacilli were demonstrated in these areas, within the giant-cells, and from the broken-down material from the interior of the cavities.

*Diagnosis.*—Acute hyperplastic splenitis secondary to a chronic tuberculous splenitis.

The third case demonstrates the effect of trauma upon an apparently normal spleen, the injury resulting in a contusion of the organ, causing a laceration of the splenic pulp, and producing an intracapsular hemorrhage. The tension upon the capsule becoming more and more intense, finally terminated in a rupture of the organ four days after the reception of the injury.

CASE III.—*Intracapsular contusion of spleen, followed by rupture of organ.* A male, fifteen years old, an American, was admitted to my service with the following history: Three days before admittance to hospital, while coasting down a hill of moderate grade, in attempting to avoid a bob sleigh, left side of

abdomen was struck by fore runner of sleigh. He was able to arise, walked one-half mile to his home, complaining only of a slight pain in left side of chest and abdomen. This pain, however, gradually became more intense, becoming localized to left superior quadrant of abdomen, and was constant. On account of the increasing severity of the pain, twelve hours after the accident a physician was summoned, who treated the case palliatively for three days, during which period the patient was slightly prostrated and presented only one symptom, that of pain. Urination was normal. There were no gastro-intestinal disturbances.

Physical examination showed a young, fairly well-developed man, markedly anæmic, prostrated, restless, respirations thoracic. Head, neck and chest were normal. The abdomen was uniformly distended; abdominal respiration was absent. There was rigidity of both recti, most marked on left side. Tenderness was present over entire epigastrium. Dulness existed on left side, extending anteriorly to within one inch of anterior axillary line and extending upward to seventh intercostal space. On the right side of abdomen, dulness reached anterior axillary line. Dulness did not shift.

Temperature was  $102^{\circ}$ ; pulse 98, regular fair volume; respirations were 22. About 18 hours after entering the hospital, pulse suddenly rose to 132, became irregular, small, and tension was below normal. Respirations rose to 28, and temperature fell to  $101^{\circ}$ . Patient became restless, jumped out of bed, abdomen became suddenly distended, and patient went into a condition of partial collapse.

On account of history of injury, of syndrome of symptoms presented, with localization of pain in left superior quadrant of abdomen, a diagnosis of ruptured spleen was made. In view of the fact that the patient had passed only 11 ounces of urine in the past 18 hours, the possibility of rupture of the kidney was also considered, although there were no pathological urinary findings.

Four hours after condition of partial collapse had come on, patient was operated upon. A median incision 10 inches long was made over middle abdomen. Abdominal cavity contained large amount of dark blood. The upper angle of incision was prolonged laterally under free border of ribs. Spleen was found lacerated and about twice normal size. In order to control hemorrhage, it was found necessary to extirpate the organ.

Patient, beyond suffering from shock subsequent to operation, made an uneventful recovery and was discharged four weeks after operation. June 9, 1911, examination showed him to be in perfect physical condition; has gained 24 pounds in weight since the accident. During past spring has entered several canoeing contests in long-distance races.

PATHOLOGICAL AND BLOOD REPORT BY DR. F. R. SANDT.

*Specimen of Spleen.*—J. W. The specimen measured 16.25 cm. in length, 11.25 cm. in width, and weighed 392 Gm. The organ was slightly enlarged, surface smooth, firm to the touch, capsule normal, edges sharp. A ragged tear extended over the anterior surface of the spleen, involving the capsule and splenic tissue to about the centre of the organ.

*Microscopical Examination.*—No pathological changes were found in the tissue except in the area about the traumatism, where there was an extensive hemorrhagic infiltration.

*Diagnosis.*—Rupture of the spleen and traumatic hemorrhagic splenitis.

*Blood Examinations.*—On admission to the hospital on Feb. 4, 1910, an examination of the blood showed the following condition: red cells 3,408,000; leucocytes 19,000; hæmoglobin 70 per cent.

Differential count: small lymphocytes, 10 per cent.; large lymphocytes, 15 per cent.; polymorphonuclear forms, 74 per cent.; eosinophiles, 1 per cent.

After operation on Feb. 5, 1910, the count was as follows: red cells, 2,472,000; leucocytes, 15,600; hæmoglobin, 30 per cent. Differential count had not materially changed: small lymphocytes, 16 per cent.; large lymphocytes, 12 per cent.; polymorphonuclear cells, 69 per cent.

On Feb. 8, 1910, three days after operation, the maximum changes were found. At this time the red cells reached their lowest point, 2,300,000; the leucocytes attained their highest point, 30,800, and the hæmoglobin was present only to the extent of 20 per cent. Differential count: small lymphocytes, 16 per cent.; large lymphocytes, 9 per cent.; polymorphonuclear forms, 75 per cent.

A gradual improvement in the blood state now ensued; the red count gradually increased, the leucocyte count fell to the neighborhood of 18,000, and the quantity of hæmoglobin slowly increased. One month after operation a count gave 4,320,000 red cells, 19,500 leucocytes, and 85 per cent. of hæmoglobin. The differential count gave 26 per cent. of small lymphocytes; 18 per cent. of large lymphocytes; 54 per cent. of polymorphonuclears, and 1 per cent. of eosinophiles.

Three months after operation, on April 15, 1910, the count was as follows: red cells, 4,600,000; leucocytes, 17,200; hæmoglobin, 85 per cent. Of the leucocytes, 20 per cent. were of the small lymphocytic variety, 6 per cent. were of the large forms, 3 per cent. were of the transitional varieties, 62 per cent. were polymorphonuclear, and 9 per cent. were eosinophilic. This count gave us the maximum number of eosinophiles.

On March 9, 1911, 13 months after operation, a count gave 4,720,000 red cells, 16,200 leucocytes, and 90 per cent. of hæmoglobin; 18 per cent. of the leucocytes were of the small lymphatic variety; 10 per cent., large lymphocytes; 3 per cent., transitional; 67 per cent., polymorphonuclears, and 2 per cent. eosinophiles.

On June 9, 1911, the results were as follows: red cells 5,560,000, leucocytes 15,800, and hæmoglobin more than 100 per cent. The differential count gave 16 per cent. small lymphocytes; 11 per cent. large lymphocytes; 9 per cent. transitional forms; 63 per cent. polymorphonuclears, and 1 per cent. eosinophiles.

*Conclusions.*—No permanent blood changes were found in this case. Sixteen months after operation a normal condition with a slight increase in the number of leucocytes was found. The leucocytes in this case seem to persist at a slightly higher level than normal. The hæmoglobin was restored more quickly, and the normal color index was found sooner than in a case to be subsequently reported.

The eosinophilia, which has been noted by other observers as following splenectomy, was only moderate in this case and developed two months after operation. No structural changes in the red cells were ever noted in any of the specimens examined.

The fourth case demonstrated the effect of traumatism upon a pathological spleen, which was probably enlarged as the result of a chronic malarial infection, the traumatism causing a contusion and laceration of the splenic pulp and the accompanying intracapsular hemorrhage. The rupture occurred 48 hours after the injury. It is of interest to note the recurrence of a malarial infection following the injury to the spleen, and the fact that, although a short course of malarial treatment was instituted at this time, there has been no recurrence of the malarial trouble since the attack occurring 10 days after the splenectomy, nor have the malarial organisms been found at any time during the past four months.

CASE IV.—Male, Holland, age twenty years, painter, while working on a roof fell from a height of 40 feet, striking left side on ground. Patient was unable to arise, was semiconscious; complained of pain in left shoulder. He was immediately taken to hospital, November 9, 1910.



*Past History.*—Patient has had frequent attacks of malaria, last attack being six months prior to accident. Was treated for chills and fever for two months.

*Physical Examination.*—With exception of slight abrasion about one inch long on forehead, head was normal. Neck and chest normal. The left shoulder drops forward, downward, inward. There is a diffuse swelling over anterior end of clavicle, over which tenderness and crepitus can be elicited. Abdomen shows only slight rigidity of left rectus, most marked lower portion where patient complains of pain on pressure. Spleen not palpable. Liver normal. No masses, no fluid made out. Pulse 110; respiration 24; temperature 99.6°. General condition was fair. Patient vomited a few times; vomitus, food and bile. About 18 hours after admission, patient went into a condition of collapse. The pulse became small, rapid, 136; tension low; respiration 24; temperature 100.8°. Abdomen slightly distended, absolutely rigid, tenderness diffuse over entirety. On account of marked rigidity and tenderness definite signs were not obtainable. Rectal examination showed mass in pelvis, which was soft and fluctuated. A Leiter coil was applied over abdomen and Murphy drip given.

About 48 hours after admission patient went into a condition of collapse; pulse became very rapid and irregular, respirations were shallow, thoracic, had a peritonitic facies and appeared markedly anæmic. Abdomen appeared board-like.

On account of history of injury, of anæmia present, together with set of symptoms presented, a diagnosis of rupture of the spleen was made. Urination being normal and there being no pathological urinary findings, rupture of kidney was not considered.

Four hours after the symptom complex had become aggravated or 52 hours after reception of injury, patient was operated upon. Incision about five inches long made along border of left rectus in upper two-thirds of abdominal wall. A large amount of chocolate-colored blood was found in peritoneal cavity. Incision was prolonged from upper angle of wound along free border of ribs and downward from lower, for distance of three inches.

Spleen was found lacerated and about four times normal size. In order to remove organ, it was found necessary to incise

costal cartilage of tenth rib near chondrocostal junction. After ligation of vessels, abdomen was flushed out with warm normal saline. A stab wound was made in flank and cigarette drain inserted. After recovery from shock of operation, patient made rapid recovery, although 15 days after operation he had a chill, rise of temperature to  $103^{\circ}$ , pulse 128, followed by profuse sweating.

Two days later, temperature rose to  $103.4^{\circ}$ , pulse 130, preceded by chill and followed by sweating. This yielded to quinine. Plasmodia found in blood. Forty-two days after admission, patient was discharged, cured.

From this time convalescence was uninterrupted. Plasmodia were found in blood 15 days after admission. Have not been found since that time, although there have been frequent examinations of the blood, the last examination made June 10, 1911.

#### PATHOLOGICAL REPORT AND BLOOD FINDINGS BY DR. F. R. SANDT.

*Specimen of Spleen.*—S. D. The specimen measured 20 cm. in length, 1.25 cm. in width, and weighed 375 Gms. The organ was somewhat enlarged, edges rounded, surface wrinkled, capsule thickened, and adherent. A laceration was noted extending over the middle of the spleen, dividing the organ for about two-thirds of its extent. The microscopical sections show a thickened capsule, prominent trabecula, and prominent Malpighian corpuscles. The splenic pulp was not distinct, and in sections stained with iodine very small mahogany-brown areas were found. The central artery of the corpuscle was normal, but the finer vessels leading from it through the corpuscle show waxy changes. Sections from the area near the traumatism show hemorrhagic infiltration.

*Diagnosis.*—Rupture of the spleen; beginning amyloid degeneration of the spleen, which is probably a secondary result of a malarial condition.

*Blood Examinations.*—A blood count made after admission to the hospital on November 10, 1910, resulted as follows: red cells, 4,000,000; leucocytes, 17,000; hæmoglobin, 70 per cent.; the differential count being normal, showing 20 per cent. of small lymphocytes; 4 per cent. of the large mononuclears; 5 per cent. of transition forms; 68 per cent. polymorphonuclears and 2 per cent. eosinophiles.

On the morning of November 12, 1910, before operation, the red cells were found to number 3,136,000, leucocytes, 37,000, and the hæmoglobin had dropped to 40 per cent.

On the evening of November 12, 1910, after operation, there was a further reduction in the red cells to 2,496,000; the leucocytes numbered 25,000, and the hæmoglobin was reduced to 35 per cent., which was the lowest point reached in this case. The number of red cells were also lower at this time than at any subsequent time. On this date there was a marked change in the differential count, the average number of cells,

as based on the two counts, giving 4 per cent. lymphocytes; 3 per cent. large mononuclears; 0.5 per cent. transition forms; 92.0 per cent. polymorphonuclears, and 0.5 per cent. of eosinophiles.

On November 13, 1910, the red cells were found to number 3,000,000; the leucocytes, 37,600; and 40 per cent. of hæmoglobin; 87 per cent. of the leucocytes being polymorphonuclear.

No material changes were found in the blood examinations, with the exception of the increase of the hæmoglobin to 50 per cent. until November 23, 1910, when the red cells dropped to 2,736,000 and the highest leucocytosis of the series, 39,600, was recorded; at this time the polymorphonuclear cells were present to the extent of 88 per cent. Nothing unusual was noted on this date, when the stained preparations were examined for the differential count, and the rise in temperature, when associated with a leucocytosis of 38,600, was attributed to a possible infection.

The periodicity and the degrees of temperature elevation on November 24, with no local evidence of suppuration, led to another examination of stained preparations, and at this time tertian malarial parasites were easily detected. They were so numerous that from four to five organisms could be found in a single microscopic field.

On November 28, 1910, after a daily administration of quinine, the red cells were found to number 3,040,000; the leucocytes, 9,200; and the hæmoglobin remained stationary at 50 per cent. At the time of this examination, the differential count showed 39 per cent. of small lymphocytes; 23 per cent. large lymphocytes; 2 per cent. transition forms; 32 per cent. polymorphonuclears and 4 per cent. eosinophiles.

From this date on until January 16, 1911, there was not much change in the blood findings, except that the red cells were gradually increased in number and the percentage of the various forms of leucocytes again became normal. The hæmoglobin did not vary, but remained constant at 50 per cent.

On January 16, 1911, the red cells had increased to 5,024,000; the leucocytes numbered 17,000; and the hæmoglobin registered 65 per cent. The differential count at this time resulted as follows: small lymphocytes, 14 per cent.; large mononuclear forms, 15 per cent.; transition forms, 5 per cent.; polymorphonuclear forms, 55 per cent.; eosinophiles, 8 per cent.; myelocytes, eosinophilic in character, 3 per cent.

The increase in the number of eosinophilic cells reached their maximum on March 6, 1911, when 14 per cent. of the leucocytes were of this form. On this date, the red cells were practically normal at 4,800,000; the leucocytes, 5,880; hæmoglobin, 70 per cent.; polymorphonuclear forms, 45 per cent.; and 17 per cent. small lymphocytes.

Subsequent counts in the case gave no additional points of interest. The final count in the case was made on June 6, 1911. The results were as follows: red cells, 5,456,000; leucocytes, 11,600; hæmoglobin, 90 per cent.; the differential count showed 15 per cent. small lymphocytes; 6 per cent. large mononuclears; 7 per cent. transition forms; 70 per cent. polymorphonuclears, and 2 per cent. eosinophiles.

The points of interest in the blood findings in this case were: 1. The absence of any marked reduction in the red cells following the operation, other than that caused by the hemorrhage resulting from the traumatism and the effects of the dilution of the blood by the saline transfusion, and the absence of any of the abnormal forms of red cells; poikilocytes, nucleated red cells, and abnormally large or small cells were not noted at any time.

2. The slow regeneration of the hæmoglobin; a low color index was noted at all examinations up to the date of the last one, when it was found to be 0.99. For three months following operation, the hæmoglobin remained constant at 50 per cent., even though the number of red cells had gradually increased to practically normal.

3. The occurrence of a moderately severe leucocytosis immediately following the hemorrhage for which operation was performed, which reached its maximum ten days after operation (39,600) and which then rapidly declined to practically normal within another week.

4. The gradual development of a moderate eosinophilia, which reached its maximum about four months after operation and which then fell to the normal limit.

5. The appearance in the blood of an active malarial process ten days after operation, at a season when there was no possibility of a fresh infection by the *Anopheles*. With the history of an active malaria during the preceding summer, can this be explained on the basis that the parasites were dormant in the spleen and were liberated into the general circulation at the time of the traumatism and hemorrhage?

6. The absolute restoration of the blood in quality, as evidenced by the normal count obtained seven months after the removal of the spleen.

In neither of the two cases which have been carefully watched since operation has there been changes in lymph-glands, enlargement of the thyroid, or pains in the long bones.

The diagnosis of contusion of the spleen causing an enlargement of the organ from intra-capsular hemorrhage can

only be made upon the previous history of trauma. There is no symptom characteristic of the condition, nor would it be possible to differentiate from a tumor of the spleen due to other pathological changes, which might have been present prior to the injury. A patient showing a tumor and evidencing pain: the splenic area following trauma in this region, particularly if accompanied by abdominal rigidity, should be carefully observed for subsequent rupture of the spleen. The diagnosis of rupture of the spleen is difficult, whether the rupture occurred at the time of injury, or the traumatism was the result of the contusion and subsequent rupture.

When rupture has occurred, the clinical picture does not differ materially from intra-abdominal hemorrhage due to rupture of other organs. It is not always possible to differentiate between rupture of the spleen and rupture of the kidney. The pressure resulting from the accumulation of blood from a ruptured spleen may cause urinary symptoms closely resembling those found in rupture of the kidney. In rupture of the kidney, we have found in several cases that on careful rectal examination there could be distinctly felt an elevation of the posterior parietal peritoneum of the left side, due to hæmatoma from the ruptured kidney, which symptom is absent in splenic hemorrhage.

I am indebted to Dr. F. R. Sandt for the careful blood observations made in these cases.

# PROLAPSED SPLEEN WITH ACUTE TORSION; SPLENOPEXY.

WITH TABLE OF UNREPORTED CASES TO DATE.

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CASE REPORT.—Mrs. W., housewife, seen in consultation with Drs. E. N. Libby and J. P. McCue. Three months ago was in hospital with an attack similar to present, but much less severe. Several slight attacks since. Patient would not go out, fearing pain would come on while away from home. No history of malaria. Four days ago patient was taken with a sharp pain in left hypochondrium, cramp-like in character, and so severe that it caused her to vomit. Pain and vomiting have persisted, with only short intervals of relief. Between attacks there is no desire to vomit. The pain is said to be much worse when lying on her right side, better when on back, and better still when holding on to lower abdomen, but touching her upper abdomen is impossible on account of "sore place" just to left and above umbilicus. She states that the pain is never in front, but always in the left side, beneath ribs. The pain is in no way referable to food, and is not relieved by vomiting. There has been no blood in the vomitus or urine. The bowels have moved well at all times, and there has been no passage of urine in relation to the attacks.

The patient is a well-developed and nourished woman. Heart, lungs, and general examination negative, except for the abdominal findings. Just below rib in left hypochondrium there is considerable tenderness, but practically no spasm of the rectus can be made out. On deep palpation a smooth, round mass may be felt, which is movable downward as far as the umbilicus and displaces easily on pressure outward toward the loin. It is acutely tender, and any degree of pressure causes the patient intense pain. On account of this tenderness it is not possible to palpate the tumor bimanually in the loin. It is apparently solid in consistency.

The white count is 8400; temperature has never been above 100°; and the urine is negative.

A diagnosis of prolapsed spleen or kidney was made, with a feeling from the ease with which it displaced toward the loin that it was a loose and twisted kidney.

Operation was advised and accepted. A lumbar incision was made and the kidney pulled into the wound. It was found only slightly movable and it was evident that it was not the tumor felt in the abdomen, as with the hand in the kidney pouch it was possible to still feel the smooth tumor through the unopened peritoneum. The kidney capsule was split and a few stitches inserted to hold it in place. The loin wound was closed and the patient turned upon her back. The abdomen was then opened through the left rectus muscle, just below the costal margin, and a large slaty-red mass dotted with flakes of fibrin brought up into the wound by the examining hand. It was evident at once that the mass was an enormously enlarged spleen, and on closer examination it was found that the broad pedicle of parietal peritoneum was so twisted on itself as to almost completely shut off its venous return. Upon the surface of the spleen were numerous fine flakes of fibrin and at one pole a small accessory spleen. On examination it was evident that the spleen was still quite closely attached to the abdominal wall at its inner pole, and that it had practically rotated upon this attachment.

The liver, kidneys, stomach, and transverse colon seemed in normal position, and were not prolapsed.

The spleen was untwisted, returned to its normal position, and fixed there by four large stitches of chromic catgut, passed through the loose peritoneum close to the spleen, which formed the pedicle, and then with the intestines well packed off, into the tissue covering the parieties, endeavoring in each case to include periosteum in the grasp of the needle. These stitches were tied, the accessory spleen removed for pathological examination, and the abdomen sutured in layers.

On coming out of ether, the patient no longer complained of pain, nor has she at any time since—now four and a half months after operation. Her recovery was uneventful, the wounds healing by first intention. She was not allowed to leave the reclining position for approximately one month. Since that time she has been about her affairs with no return of symptoms in the slightest degree.

The pathological report of sections taken from the accessory spleen was normal spleen tissue, except for enormous congestion.

An examination of the abdomen at this time, four and a half months after operation, finds the spleen just palpable below the costal border, and not movable to any extent from side to side.

*Etiology.*—Prolapse of the spleen occurs as a part of general enteroptosis, or may be caused by congenital anomalies, such as abnormal length of the ligaments or by acquired lengthening, the result either of trauma or increased weight of the spleen, due to malaria, leukæmia, or pseudoleukæmia. As a proof of the congenital origin of the relaxation of the splenic ligaments, Osler cites its occurrence in different members of the same family.

It is an interesting fact that, although prolapse of the spleen occurs commonly with general enteroptosis, in a majority of the cases operated upon and reported, nothing is said of ptosis of the other organs, and in this case, as is stated in the history, the abdominal organs were in apparently normal position.

*Diagnosis.*—The diagnosis of prolapsed spleen is made from the shape and position of the organ, and may be confirmed by palpation of its edges and by the most confirmatory sign of all, the feeling of the splenic notches. In certain instances it is said that the vessels entering the spleen may be palpated. The diagnosis is also aided by ruling out kidney prolapse after ascertaining that both kidneys are in normal position. In most cases where the diagnosis has been made, the splenic notches have been felt.

*Symptoms.*—In all cases of torsion there is great pain, due to dragging on the pedicle from the additional weight of the congested spleen, stretching of the capsule from the same cause, and the occurrence of an acutely tender mass, as a rule movable in all directions unless surrounded by adhesions. Temperature, pulse, vomiting, and shock are dependent upon the degree of torsion.

*Treatment.*—The indications are to remove the twist and to



restore the organ to as near normal conditions as possible with a reasonable prospect of its remaining so, and if this is not possible, to remove it. In the list of cases reported since June, 1908, only one is spoken of in which splenopexy was done, and in this case gauze packing was also used. In another the spleen was simply untwisted and no attempt made to restore it to place; and in another, gauze packs and a belt were used. In the remaining cases splenectomy was practised. There were no fatal results in any of the methods of treatment.

In nearly all of the treatises on surgery, splenectomy is recommended and splenopexy condemned because of the proneness, it is stated, of the prolapse to recur in cases with a marked degree of descent. That this is true seems more than likely, yet in view of the lessened danger, the somewhat hazy idea which we still have about the spleen, and the success of the simple procedure in these three cases and in other cases reported in the earlier literature, it seems that there must be a place for splenopexy, either by suture, packing, or pouch. In a certain group of cases similar, I believe, to the case here described, in which all of the supporting structures of the spleen are not yet gone and the spleen has not prolapsed into the lower abdomen, also in those cases in which time is of the greatest value on account of previous shock or exhaustion from pulling on the splenic pedicle or the suffering which goes with it, untwisting the pedicle and suturing into as near normal position as possible, with packing or not, will be the most rational treatment, and the place most suitable for splenopexy.

In those cases where the spleen is in the pelvis, or low down in the abdomen, with a long and corded pedicle making splenectomy rapid and simple, it will be the operation of choice, with only slight danger and an absolute guarantee of non-recurrence.

In this case to have removed the spleen would have been a much different problem than the simple removal of a spleen with a long pedicle, and would have added a degree of risk that would have been unjustifiable.

In an article on splenectomy, George Ben Johnson reports

the occurrence, prior to 1890, of splenectomy for torsion five times, with four deaths; between 1890 and 1900, eleven times, with four deaths; and between 1900 and 1908, eleven times, without a death.

Below is submitted the cases of prolapsed spleen with torsion reported in the literature since that date (June, 1908); six treated by splenectomy without a death; one by simple untwisting resulting in recovery; one by untwisting and packing; two, including the author's, by splenopexy, resulting in recovery.

C. R. Blackburn and R. G. Craig. Australian Med. Gaz., Dec., 1907, vol. xxvi, p. 615. Replaced from pelvis and held by pads. Good recovery.

Asa B. Davis. Bull. of the Lying-In Hosp. of N. Y. City, vol. v, No. 1, p. 24, June, 1908. Splenectomy while pregnant. Recovery and normal delivery.

J. E. Gemmell. Jour. of Obstetrics and Gyn. of British Empire, London, Oct., 1908. Untwisted and not removed on account of patient's condition. Seen a year later without symptoms.

J. E. Gemmell. Jour. of Obstetrics and Gyn. of British Empire, London, Oct., 1908. Splenectomy. Recovery.

Adam Reuterskiöld and Artur Vestberg. Upsala Läkareförenings Förhandlingar, June 20, xiii, No. 5, p. 355. Splenectomy. Recovery.

P. Paterson. London Lancet, No. 20, 1909. Splenectomy. Recovery.

I. MacDonald and W. A. Mackay, London Lancet, Sept. 25, 1909. Splenectomy. Recovery.

W. J. Mayo. Jour. A. M. A., vol. liv, No. 1, p. 14. Suture and packing. Recovery.

## CYSTS OF THE OMENTUM.\*

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CYSTS of the omentum are uncommon; they give two main varieties of interest: (1) practical, referring to their diagnosis and treatment; (2) academic, referring to their origin.

1. From the practical stand-point we may remember that at rare intervals these cysts are found, that their symptoms in non-malignant cases are mainly mechanical, due to pressure or traction on surrounding structures, and that operations have in the main been successful and free from serious difficulty, about 86 per cent. of the reported cases having ended in recovery.

2. Origin: The origin in most of the cases has been apparently similar to that of mesenteric cysts. In a discussion of mesenteric cysts held before this society several years ago, the members assented to their classification into: (1) embryonic cysts; (2) cystic malignant disease; (3) echinococcus cysts.

Most of the cysts of the omentum may be included in the same classification, for it is evident that embryonic rests may occur between the peritoneal layers of the omentum as they do between those of the mesentery, although such occurrence is less common.

Cystic malignant disease and echinococcus cysts are occasionally found in the omentum, but their consideration does not properly come within the limits of this paper.

A number of very able articles have been written on omental cysts, among which we may particularly mention that by Hasbrouck.<sup>1</sup> By its aid and with a pains-taking search of the literature, Doctor Farr has prepared the following table.

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\* Read before the New York Surgical Society, March 22, 1911.

## TABULATED DESCRIPTION OF OMENTAL CYSTS, EXCLUDING ECHINO-

Number	Age	Sex	Result	Symptoms	Cyst Wall						Lining			Contents				
					Thick	Thin	Unilocular	Multilocular	Closed sac	Fluid in folds of omentum	Endothelium	Epithelium	Fibrous	Clear or light colored fluid	Dark colored fluid	Coagulated blood	Milky	Pus
1	Adult	F.	D.	Not given.					+ large					+				
2	44	M.	D.	Anuria(?).		+ 1mm		+					+			+		
3	58	F.	C.	Like ovarian cyst.											+			
4	19	F.	C.	Pain at menses. Vomiting. Shooting pain Ailing gen'ly.			+?		+					+				
5	4	F.	C.			+	+							+				
6	48	M.	C.					+					+		+			
7	22	F.	C.	No pain, Sudden growth. Emaciation.		+	+				o		+	+				
8	2½	F.	C.						+							+		
9	Adult	F.	C.															
10	8	M.	C.	Dyspnœa Frequency.				+							+			
11	4	F.	C.	None.		+	+							+				
12	7	F.	C.	Emaciation.		+		+			+			+				
13	1 yr 8 mo.	F.	C.	Pain. Diarrhœa.		+		+					+		+			
14	21	M.	D.	General condition bad.	+											+		
15	1	F.	C.	Anorexia, Vomiting, Constipation.		+		+						+	Rose			
16	11	M.	C.	Vomiting, Pain, Anorexia, Emaciation.		+	+?								+			
17	9½	F.	C.	Emaciation.		+		+							+			
18	2½	F.	C.	Indigestion.						+					+			
19	17	F.	C.	None but pressure.			+						+	+	+			
20	6	M.	C?	Pain.		+		+						+				
21	19	F.	C.	Pain.			+?						+		+	+		
22	4	M.	C.	Tenderness. Emaciation.		3mm	+			+			+	+	+	+		
23	15	F.	C.			+		+			+		+	+	+	+		
24	51	F.	C.			+		+			+		+	+	+	+		
25	51	M.	C.	Vomiting. Emaciation.		2-4 mm							+		+			
26	4½	F.	C.	Gastro-enteritis.		+		+			+		+	+				
27	Child	M.	C.			+	+						+		+			
28	50	F.	C.			+		+			+		+	+	+			
29	4	M.	?	None.		+		+			+	+	+	+	+			
30	38	F.	D.			+		+			+?		+	+	+			
31	50	M.	D.			+		+				+		+				
32	8	F.	C.	Pain. Vomiting.	½"		+											+
33	26	F.	C.					+										
34	37	F.	C.	None.		+	+								+			
35	43	F.	C.	Pain. Vomiting.	+	7 mm							+		+			
36	8	M.	C.	Dyspnœa. Vague pain.			+?						+		+			
37	62	M.	C.	Dyspnœa. Emaciation Weakness.	+									+				

## COCCUS CYSTS AND CYSTIC MALIGNANT DISEASES. BY CHAS. E. FARR, M.D.

Remarks	References
Autopsy specimen	Gairdner, W. T.: Trans. Path. Soc., London (1850-51), 1852, iii, 374.
Present 12 years. Autopsy specimen	Simon, E.: Bull. Soc. Anat. d. Paris, 1858, xxxiii, 30.
Many years	Doran, Alban: Trans. Obst. Soc., London, 1882, xxiii, 164.
Followed blow. Present 1 year	Gooding, J. C.: Lancet, London, 1887, i, 311.
Contained 4 pints	Wells, Spencer: Brit. Med. Jour., 1890, i, 1362.
No trauma. [Small cell sarcoma in wall.] Gradual development	Cazin, M.: Bull. Soc. Anat. d. Paris, 1893, lxxviii, 312.
Vascular inner wall. Contained 9 litres (partly necrotic material)	Erdheim, S.: Wien. klin. Rundschau, 1896, x, 131.
Large hemorrhagic	Marfin, A. B.: Press. Med., Paris, 1896, 133.
Albuminous fluid and cholesterin	Jessett, F. B.: Brit. Gynæc. Journ., 1896-7, xii, 156.
Abdomen measured 44 in. Omental cyst diagnosed	Hearn, W. J.: ANNALS OF SURGERY, 1897, xxv, i, 703.
Iridescent patches; 3½ pints	Braithwaite, J.: Lancet, London, 1898, ii, 1472.
Ten pints	Jacobi, A.: Trans. Assoc. Am. Phys., 1901, xvi, 232.
Blow on stomach 3 mos. before. Communicated to stomach	Marsh and Monsarratt: Brit. Med. Journ., London, 1901, i, 511.
Few red blood-cells	Catman, H. H.: Brit. Med. Journ., London, 1902, i, 1267.
Had a lining membrane. Attached to pancreas; 12 pints	Schramm, H.: Zentralb. f. Chir., 1903, xxx, 564.
32 pints	Boyd, S.: Clin. Journ., London, 1903, xxi, 306.
Bloody fluid	Young, W. McG.: Lancet, London, 1905, i, 157.
60 lbs.	Fort, R. E.: ANNALS OF SURGERY, 1907, xlv, iii, 382.
Smooth lining membrane	Rodman, J. S.: ANNALS OF SURGERY, 1909, xlix, 427.
Unaltered blood; short duration; 2½ litres	Gifford, A. H.: Brit. Med. Journ., London, 1910, i, 1289.
"Lymphangiectasis"	Holleman: Zentralblatt f. Gynäk., 1908, xxxii, 297.
Bloody fluid	Seefisch, G.: Deutsche med. Wchenschr., Leipsig, 1909, xxxv, 1790.
Reddish jelly-like, partly calcified wall	Brandt: Zentralbl. f. Gynäk., 1894, n. 991.
By Czerny	Wagener: Nederl. Tijdschrift v. Geneesk., 1902, dl. 2.
Chocolate colored fluid. Clinic of Prof. Signori	Ris: Bruns Beiträge z. klin. Chir., x, 1893, 423.
Died later—autopsy	Schwarzenberger, B.: Bruns Beiträge z. klin. Chir., Tubing., 1894, xi, 713.
Noticed 2 years	Costa, Tomasso: Giornale internaz. del Scienze, Med., 1908, xxx, 357.
Some ciliated cells in lining. Autopsy case (pyæmia)	Himmelheber, K.: Archiv. f. Gynäk., 1909, lxxxvii, 67.
Autopsy specimen. Contents homogeneous	Wakefield, W. F. B.: Trans. Am. Gyn. Ass'n, 1907, xxxii, 447.
Suppurating dermoid; 3 plates of bone; pus	Karás, Henrietta: Virchow's Archiv., Bd. clxxxviii, 138.
Present 6 years; much ascites; 75 lbs.; fluid too thick to run	Henke: Verhandl. d. deutsche path. Gesell., Bd. ii.
No trauma; wall partly gangrenous	Waldy, J.: Lancet, 1889, vol. ii, 642.
Few blood-cells; no epi- or endothelium; lesser omentum	Ormsby: Med. Press and Circular, London, 1883, vol. xxv, 258.
No trauma; few blood-cells; lymphangioma	Edebohls: New York Journ. Obst. and Gyn., 1893, vol. iii, 614.
Cystic tumor	Schwartz, Rodolfo: Gazet. degli Ospedali, 1902, vol. xxiii, 764.
	Mathews, Paul: Brit. Med. Journ., 1905, vol. ii, 1642.
	Bidwell, Leonard J.: Brit. Med. Journ., 1905, vol. ii, 806.

It will be seen that most of the cases have been very incompletely reported, and that there have been few exhaustive descriptions of the cyst walls and the cyst fluid, hence it is impossible to reason with accuracy as to their origin. Apparently most and possibly all of these cysts were of embryonic origin. One must, however, notice how large a proportion of them gave evidences of blood in their contents—four of them contained coagulated blood, eighteen contained fluid so dark in color that they had apparently contained blood.

It is self-evident that an ordinary hæmatoma in the omentum should not be described as a cyst, but the results of hemorrhage into the omentum may well receive further study and it is believed that the case here reported may throw some light on the subject.

**CASE HISTORY, No. 657 B.**—G. R., aged twenty-six, a clerk and football player, admitted to Roosevelt Hospital, June 30, 1910. Discharged cured, July 8. Diagnosis, cyst of omentum.

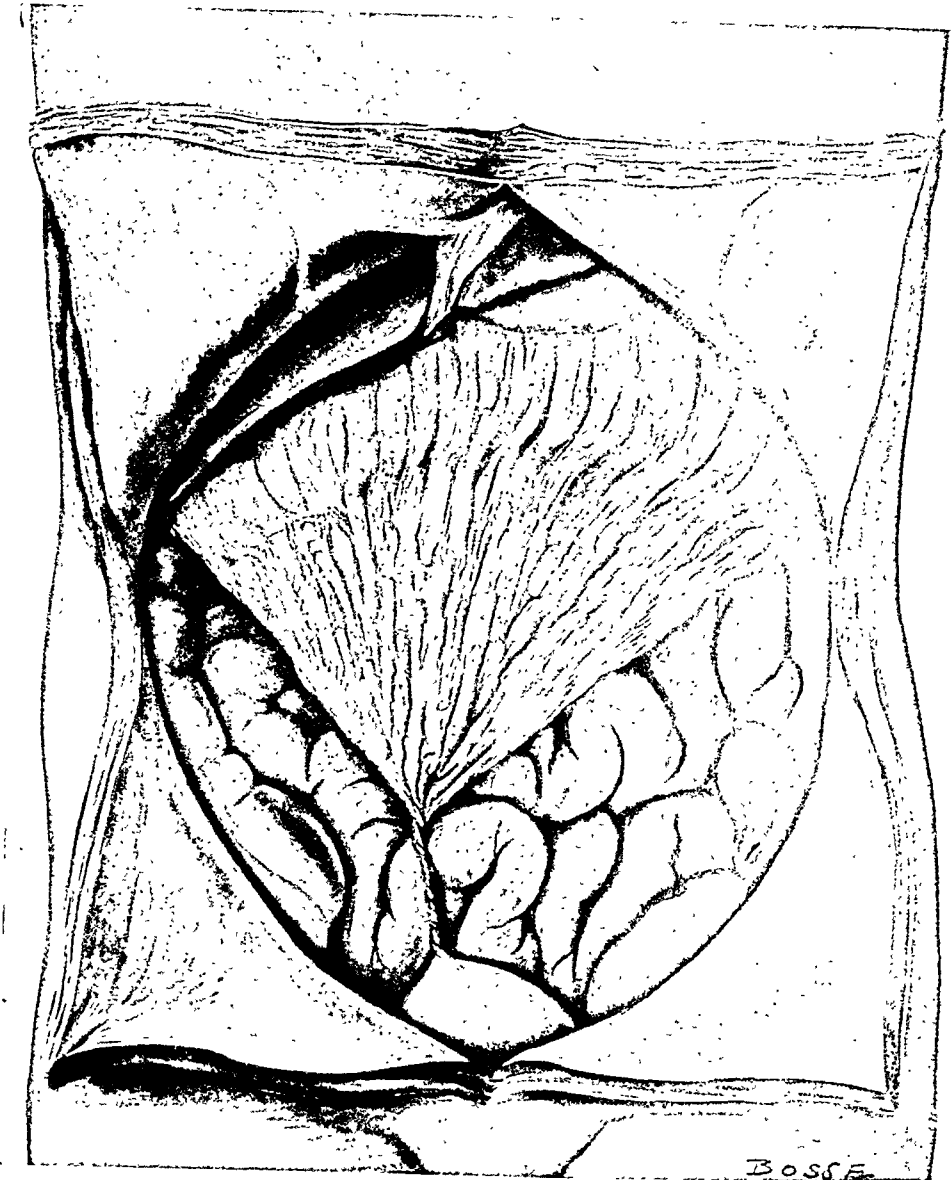
*Chief Complaint.*—Lump in abdomen.

*Present Illness.*—Fifteen months ago while straining at stool, he felt something “snap” inside of him, and immediately began to feel very faint. He collapsed for several minutes, then recovered, then went to bed for ten days on account of weakness and pain in abdomen. He was nauseated and vomited once or twice. After lying in bed for ten days he felt well again. About four months ago he noticed a lump in the left side of the abdomen about half as large as a hen’s egg. This lump apparently increases and diminishes in size; he thinks it is slowly getting larger. There has been constantly a dull aching pain in the tumor. No pulsation noted. Patient is habitually constipated. No fever. Appetite good. Has had acute attacks of cramp-like abdominal pain, about six attacks.

*Past History.*—Negative for infectious or contagious diseases except measles. Cardiorespiratory, negative. Gastro-intestinal, no stomach symptoms. Constipation. Abdomen too full, patient says. Urinary, negative. No gonorrhœa or lues. Alcohol in moderation.

*Family History.*—Negative to neoplasm or tuberculosis. Father died of stomach trouble.

FIG. 1.



Diagrammatic drawing of omental cyst with torsion of its pedicle.





*Physical Examination.*—Patient is a well-nourished young man, who does not look to be acutely ill. He shows no abnormality excepting in the lower part of the abdomen, where a tumor can be felt. It is  $2\frac{1}{2}$  inches below the umbilicus and extends to the left from the median line. It seems about as large as an orange. It is firm, smooth, and apparently is not in anterior abdominal wall. Firm pressure over it causes pain. It is somewhat movable. No pulsation can be made out. No murmur is heard. Pressure seems to make no difference in size of tumor.

*Operation.*—Anæsthetic: gas and ether. Median incision. A cyst about as large as a grape fruit was found attached to the pelvic peritoneum; it had a pedicle above, which was composed of twisted omentum (see diagram). Its wall was thin. The tension of the fluid was moderate. A fold of peritoneum extended upward on to its anterior wall; when this was peeled down the cyst wall proper was found to be continuous with the omental peritoneum. The fluid was aspirated and found to be clear, thin, and watery. The cyst was then separated from its pelvic adhesions; its pedicle was ligated, and it was removed. On section the cyst wall was found to be composed of omental peritoneum and fibrous tissue into which this peritoneum was incorporated. Within this wall and pressed firmly against it there was a friable layer of coagulated fibrin. The patient made an uninterrupted recovery.

*Pathological Report* (Dr. Mortimer Warren).—The tumor was a cyst about the size of a large orange, and contained 8 to 10 oz. of clear fluid. It was covered with peritoneum. Beneath the peritoneum there was a rather thick layer which was bluish-green in color and very friable, breaking on being touched. The pedicle of the tumor was composed of mesentery twisted on itself many times.

*Microscopical Examination.*—Showed that the cyst wall was composed of fibrous tissue congested and infiltrated with round cells. It contained many blood-vessels and showed evidences of inflammation. The inner layer was coagulated fibrin and showed no definite cellular structure.

The cyst fluid was pale in color, sp. gr. 1008, albumin 1 per cent. (in bulk). There were a few blood-cells which apparently got into the fluid during the operation. Their examination showed a ratio of 216 red blood-cells to 36 white blood-cells.

A differential count showed: 4 per cent. polymorphonuclear cells; 60 per cent. lymphocytes; 36 per cent. endothelial cells. The fluid was apparently a transudate, not an exudate. There were no bacteria.

*Probable Method of the Formation of the Cyst.*—The facts that this cyst wall was little more than thickened peritoneum and that there was a layer of coagulated fibrin within it, lead one to wonder whether it could have been the result of an omental hæmatoma. Furthermore, the patient's history suggests such a formation. The attack came on suddenly while he was straining, he felt as though something had given way, he fainted and had to be in bed for several days, he had been subjected to frequent traumatisms, and hence was more apt than the average person to have omental hemiorrhage. One who believes the cyst to have been the result of hemorrhage should explain the absence of hæmoglobin in its contents, the very light specific gravity of its fluid, and the apparent increase in the size of the cyst and in the pain.

*Absence of Hæmoglobin in Fluid.*—Adami and Bradley have explained the disappearance of the hæmoglobin.

Adami,<sup>2</sup> writing of hemorrhagic cysts, says: "Extensive hemorrhages into the substances of sundry organs may result not in the ultimate absorption of the exuded fluid but in cyst formation. The hemorrhage leads to the destruction of the tissue of the infiltrated area; eventually a capsule is found around the exuded blood, but while this is proceeding, through the combined agencies of leucocytes and autolysis the bodies of the corpuscles and the cell débris undergo removal, as does also the diffused and altered hæmoglobin, so that, after a few weeks, the cyst is found to contain a thin, blood-stained fluid, and eventually all the contents come to be a clear serous fluid. The last indication of the hemorrhagic origin of such a cyst is the presence of modified blood pigment in and around the fibrous capsule. The organs in which such hemorrhagic cysts are specially liable to be found are the brain, goitrous thyroid, scalp of the newborn and children (cephalhæmatoma), pinnæ of ears (football players and lunatics) (othæmatoma)."

Bradley<sup>3</sup> has studied the same process in the thyroid gland, and has described seven thyroid cysts which showed

hemorrhagic origin and illustrated different stages of cyst development and absorption of hæmoglobin.

Brain cysts which were the sequelæ of hemorrhages and which contained clear fluid have been very often described, and they offer very good examples of the process under consideration.

*Light Specific Gravity of the Fluid.*—In speaking of the fluid, Dr. Warren said that it seemed like the fluid of œdema, not like the fluid ordinarily found within a cyst. Its specific gravity, 1008, was much less than that of blood, which is about 1060. Its content of albumin, 1 per cent. (by bulk), was also a small fraction of that in blood-serum, which is about 50 per cent. when estimated by the same method.

Can the light character of this fluid be explained by the twisted pedicle of the cyst? One may well believe that it can. Much has been written about torsion of the omentum. In 1900 Wiener<sup>4</sup> tabulated seven cases; in 1905 Corner and Pinches<sup>5</sup> 53 cases, and in 1910 Finsterer<sup>6</sup> 72 cases, and records of a few other cases are to be found in the literature. Most of the cases (90 per cent.) have been associated with hernia.

The omentum has been twisted between two fixed points in 23 per cent. of the cases (Pretzsch<sup>7</sup>), its lower edge has been free in 77 per cent. This torsion is not so common as that of ovarian cyst pedicle and probably not so common as volvulus of the intestine. Either the existence of an omental hæmatoma or the adhesion of the omentum to the pelvic peritoneum would give conditions for omental torsion, and the existence of such a torsion in this patient is not to be wondered at. Torsion might easily cause œdema below the pedicle, and in a cyst with indefinite vascular walls this œdema might easily determine the character of the contained fluid; the watery elements being present in a larger proportion than in ordinary cysts.

The symptoms of torsion of the omentum have usually simulated those of strangulated hernia or appendicitis (sudden pain, nausea or vomiting, constipation, tenderness, rigidity,

etc.), and the attacks of pain and the discomfort which this patient had were probably in large measure due to the omental torsion.

*Summary.*—The cyst formation in this case is believed to have been due to the following elements:

1. Hemorrhage into the greater omentum, forming a hæmatoma.

2. Absorption of the hæmoglobin and degeneration of the blood-cells, as described by Adami and Bradley.

3. Torsion of the omentum, as in cases tabulated by Finsterer and others, with consequent œdema and transudation of the watery elements of the serum into the cyst cavity.

The attacks of pain were similar to those which have been described by patients with omental torsion.

The condition must be a rare one, but in these days of careful study of abdominal conditions, it surely has a practical as well as an academic bearing.

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<sup>3</sup> Bradley: *Journal of Experimental Medicine*, vol. i, p. 401.

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<sup>6</sup> Finsterer: *Brun's Beiträge zur klin. Chir.*, 1910, vol. lxxviii, p. 52.

<sup>7</sup> Pretzsch: *Brun's Beiträge zur klin. Chir.*, 1906, vol. xlviii, p. 118.

# LINITIS PLASTICA (CIRRHOSIS OF STOMACH).

WITH A REPORT OF A CASE CURED BY GASTRO-JEJUNOSTOMY.

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THE term *linitis plastica* was used by Brinton to designate a special disease of the stomach, benign in nature, characterized, pathologically, by a diffuse or circumscribed increase in the connective tissue involving chiefly the submucosa, and to a lesser degree the other layers, giving rise to a marked thickening of the stomach walls with a corresponding diminution in its lumen; clinically, by its insidious onset, its slow progressive gastric symptoms, its cachexia, and fatal termination.

*Nomenclature.*—In searching the literature the following synonyms for the disease are found: (1) chronic interstitial gastritis; (2) sclerosis of stomach (Sneller); (3) fibroid induration (Handfield Jones); (4) fibroid disease of pylorus (Haberson); (5) hypertrophy with induration (Cruveilhier); (6) submucous hypertrophy; (7) submucous sclerosis with chronic gastritis and callous retroperitonitis (Hanot and Gombault); (8) hypertrophic stenosing gastritis (Boas); (9) hypertrophic stenosis of pylorus (Lebert); (10) fusocellular sarcoma (Lyonnet); (11) plastic linitis (Brinton); (12) cirrhosis of the stomach; (13) endogastritis obliterans (Leersum); (14) Magenschrumpfung; (15) Zuckergussmagen; (16) hypertrophy of the stomach (Fox); hypertrophic sclerosis of the submucosa (Bouvert); (17) atrophy of stomach (Fenwick); (18) Cirrhotische Verkleinerung des Magens (Nothnagel); (19) cancer conjunctif sous-muqueux (Bard et Garret); (20) neurofibromatose carcinomatose (Curtis); (21) gastro-intestinal sclerostenosis (Krompecher).

*History.*—The condition of scirrhus of the stomach had been recognized two to three centuries before Brinton's description. These early descriptions were scattered and incomplete, Lieutaud (1779), Voegtel (1804), Pohl (1804). In the second quarter of the nineteenth century the observations became more frequent. In France, Andral (1835), Cruveilhier (1835), Monnert (1841), Salse (1844), Bérault (1847), Lebert (1845), Boyer (1848), Broca (1850) described the condition. Andral's, Cruveilhier's, and Broca's descriptions are clear-cut, and definitely state that the lesion is benign. Lebert recorded a case in which the stomach, colon, and rectum were involved.

In Germany Gluge (1850) described a case of complete involvement of the stomach, Brant (1851), one in which the lesion was found in the stomach and cæcum. By these authors the lesion was held to be benign. In Austria Rokitansky (1859) stoutly maintained that the submucous hypertrophies were nothing else than fibroid cancers.

To Brinton (1854) belongs the credit of attempting to establish it as a separate and distinct disease of the stomach. He gave to it the name *linitis plastica* (cirrhotic inflammation).

Of the terms offered, Brinton's baptismal name has won the most favor. This is especially true of the French and Italian literature. In his search for a distinctive title he suggests "that the inflammation of the filamentous network of areolar tissue, which seems to be the main characteristic of the lesion, might be well expressed by such a word as *linitis*" (from the Homeric *λίον*, *ex lino factum*). He rejects the term *interstitial gastritis* "as the involvement of the mucous membrane is inconstant, late, and incidental"; *hypertrophy*, as it is an evident misnomer; *fibroid infiltration*, because it is not a true histological likeness.

Contemporary with Brinton the English observers, Handfield Jones, Wilks, Fox, Habershon, Hare, and Quain reported cases and considered the affection benign. For a considerable period following Brinton's observations, the view

that the lesion was benign met with the most favor. This was materially strengthened by the admirable articles of Hanot and Gombault (1882), Tourlet (1902). On the other hand, Garret (1892), Bret and Paviot (1894), Hoche (1903), Schacher (1903), forcibly declared the lesion to be malignant. This later conclusion dominates the French and Italian literature of to-day.

Opposed to this we have the operative findings and results of von Eiselberg (1902), Roux (1903), Sheldon (1904), Jonnesco and Grossman (1905), Deaver (1906), Lyle (1908), and the most excellent article of Kurt von Sury (1907).

*Nature and Pathogenesis.*—The pathogenesis of this affection is not yet clear, and it is impossible to say which of the many theories is correct. Brinton was well aware of the difficulty of making any definite statement, and warns that nothing short of "careful histories of cases during life and still more careful examinations of the corresponding specimens after death, in a far larger number than are at present at our disposal, can afford materials for any safe deductions." He recognizes the fact that a careful examination of the stomach may not reveal anything suggestive of cancer, yet the adjacent glands, lungs, liver, etc., may yield cancerous deposits.

Among the numerous theories that have been advanced are: that it is a stage of advanced gastritis; a primary atrophy (Fenwick); a result of chronic passive hyperæmia due to cardiac insufficiency (von Sury). Pedrazzini believes it to be a manifestation of senility; Huchard, an arteriosclerosis; and Poncet, Leriche, Villiers, and Phillippen claim that it has a tubercular element. Bouvert thinks it is due to a lymphatic obstruction; Wilks, that it is a primitive sclerosis of the submucosa; Garret and Bard, that it is a secondary sclerosis following a fusiform sarcoma. Bret and Paviot maintain that it is secondary to an infiltrating epithelioma. Shacher holds that it is an epithelioma pure and simple, starting from the mucosa, infiltrating the gastric walls, causing an irritative

connective-tissue hyperplasia, this irritation producing epithelial buds. Hoche maintains that it is an infiltrating epithelioma arising from an old cicatrizing ulcer. Danel's view is similar, but he places special stress on the cancerous involvement of the glands. Hanseman, in his work on endothelioma, says that many of the so-called scirrhus infiltrations of the stomach are endothelioma.

Delebet claims that linitis plastica is a diffuse cancer of the stomach. "The interest is not so much the question of the nature but how it advances. In linitis plastica secondary nests have been observed in all parts of the intestine; these could be attributed to primitive cell nests because they appear not in the mucosa, but in the cellular or muscular layers and others on the mesenteric side." They are due to a retrograde invasion of the lymphatics; they present a phenomenon identical to the one Handley has described in the breast under the name of permeation; this mechanism is not habitual, on the contrary it is only in these cases. The secondary nodules, which in ordinary cancers of the stomach are most often found in the liver, are lacking in a great majority of recorded cases.

In all these theories only two distinct ideas have been expressed: one, that linitis plastica is a special affection of an indefinite nature and cause; the other, that linitis plastica is a special form of scirrhus cancer.

Krompecher holds that gastro-intestinal sclerostenosis is not a mere disease of the pylorus, but is found in the intestines and peritoneum, and that it is the result of a chronic venous œdema caused by cardiac insufficiency and arteriosclerosis; and that the pathological process bears a close relation to scleroderma. (See Krompecher's conclusion, Case 70.)

*Pathology.*—Two forms are recognized, the local and the general. In the localized form we find indurated plaques on different portions of the viscus. This is rare. Viti's case is an example. The more common variety of this form is the one which is found in the pyloric region, forming a plaque of varying extent, often encircling and stenosing the pylorus.



Examples of this are the cases of Habersohn, Tilger, Boas, Chaput and Pillet, Brissaud, Oettenger and Tourlet. It is natural to suppose that the obstruction to the pylorus would lead to a dilatation of the stomach. This is seldom met with (exception, Nauwerk). The infiltration shades insensibly into the normal stomach tissue, but stops abruptly at the duodenum. An exception to this is Marcy and Griffith's case, where the infiltration extends to the duodenal entrance of the common duct. Herrenschmidt's case, in which the process has extended into the duodenum, pancreatic ducts, and common bile-duct, cannot be considered as an exception, for it is not a true linitis plastica.

In the generalized form the stomach may be normal in size, dilated, or contracted. Contraction is the rule, dilatation the exception. In a typical case we find a shrunken, thick-walled tube lying transversely across the epigastrium, suggesting by its size a segment of the large intestine. Often the walls of such a case are so rigid that if the stomach be removed it does not collapse but maintains its original shape. The peculiar dull grayish color of the peritoneum gives to the surface of the stomach a scarred looking appearance.

On section the stomach wall is greatly increased in thickness. Brinton says it may be six to eight times as thick as the normal wall. Despite the infiltration the layers remain distinct.

In the advanced cases all the coats are involved, the most marked involvement being in the submucosa, subserosa and serosa. According to Brinton the submucosa is ten to twenty times its normal thickness, the serosa and subserosa seven to ten times, the muscularis five to eight times, and the mucosa two to three times. The mucosa is often normal in appearance, "the secretory structures remaining substantially healthy," or it may be thickened and merged into the adjacent layers. Primitive atrophy is infrequent, ulceration rare. When there is marked involvement of the walls the knife fairly creaks as if it were cutting through cartilage. The cut section is comparatively bloodless, and no cancer juice can be

expressed. Tumor formation is uncommon; it is a flat infiltrating process. The lymphatic glands are small and hard, sometimes enlarged.

In the majority of cases evidences of an associated subacute or chronic peritonitis are prominent: lymph on the coils of the intestine, fibrous adhesions, ascites, thickening and opacities of lesser and greater omentum, white waxy-like plaques on the visceral and parietal peritoneum, thickening of the retroperitoneal tissue (retroperitoneal callus of Hanot and Gombault).

Analogous lesions are found in the colon, rectum, and small intestine. These lesions start from the mesenteric attachment and suggest a retrograde lymphatic involvement. These secondary involvements are considered by Bret and Paviot to be cancerous. Krompecher concludes that they are benign and suggests the similarity between the lesions and scleroderma.

*Microscopical Examination.*—The mucosa may be normal, or it may show evidences of a chronic productive or atrophic gastritis. In the advanced cases we meet with cystic dilatation of the tubules, constrictions, and other anomalies due to the pressure effects of the infiltrating connective tissue. This infiltration may lead to a sclerosis with atrophy, causing a complete disappearance of all the glandular elements (example, Osler's case).

The most marked and constant lesion found is a diffuse hypertrophy of the connective-tissue elements of the submucosa. The bundles of white connective tissues traverse the layers in irregular bands, surrounding the blood-vessels and interlacing with one another. The blood-vessels may show signs of endarteritis. The resemblance which this tangled interlacement of fibres bears to the weave of sail-cloth suggested to Brinton's mind the term "linitis."

It is a disputed question whether the epithelial cells found in the submucosa and muscularis are carcinomatous or whether they spring from the endothelium lining the normal lymph

spaces. The majority of observers consider these nests to be evidences of cancer. In the muscularis there is a combination of hypertrophy and atrophy of the muscle fibres. Bands of connective tissue are found passing from the submucosa through the muscularis to the subserosa. The subserosa shows a marked connective-tissue infiltration, the serosa a destruction of the endothelial cells. The lymphatic glands when involved show a chronic connective-tissue fibrosis.

In forming a mental picture of this lesion we are struck by the sharp contrast between the integrity of the mucosa with its absence of ulceration and the enormous thickening of the submucosa.

*Etiology.*—It is a disease of adult life. In Table A (true linitis plastica), the total number of cases in which the age is given is 64. Excluding three of these (Nos. 8, 55, 57) which cannot be properly admitted, the remaining 61 are grouped as follows:

Between 20-30 years .....	6 cases
Between 30-40 years .....	13 cases
Between 40-50 years .....	17 cases
Between 50-60 years .....	11 cases
Between 60-70 years .....	12 cases
Between 70-80 years .....	2 cases

In Table B (so-called malignant linitis plastica), the total number of cases in which the age is given is 54. Excluding Nos. 36 and 50, the remaining 52 are grouped as follows:

Between 20-30 years .....	6 cases
Between 30-40 years .....	9 cases
Between 40-50 years .....	10 cases
Between 50-60 years .....	12 cases
Between 60-70 years .....	11 cases
Between 70-80 years .....	4 cases

It is more often found in men than in women. In Table A (true linitis plastica), there are 41 men; 22 women. Sex not given in 15 cases.

In Table B (so-called malignant linitis plastica), there are 33 men; 19 women. Sex not given in 5 cases.

A considerable number of the cases give a history of cardiac or arterial trouble; a few give an alcoholic history. Syphilis is not a factor. Multiple peptic ulcers have been advanced as a cause. Poncet, Leriche, Villiers, and Phillippen believe that tuberculosis plays an important part. Occupation trauma was noted in the cases of Hare, Snellen, and Schacher. Ascites and peritonitis are results, not causes.

*Symptoms.*—There were no symptoms referable to the stomach in Viti's case, the antemortem diagnosis being chronic bronchitis and arteriosclerosis. Halipré's and Beaurain's second case gave a rheumatic history, their third case died of diabetes; leucoplakial plaques were found in the mouth. In Bouchard's and Kurt von Sury's cases the stomach symptoms were overshadowed by arteriosclerosis and cardiac complications. The diagnosis was not made until a few months before death. In the great majority of cases the onset is insidious; in a few abrupt. For months or years there is an indefinite history of dyspepsia, then definite progressive gastric symptoms appear, followed by severe anæmia, starvation, cachexia, and death.

In the first stage the symptoms are vague and inconstant, they are best described by the term indefinite dyspepsia. These symptoms gradually give way to a more or less constant anorexia, occasional vomiting, and an indistinct gastric pain and tenderness.

The involvement of the peritoneum brings its own train of symptoms according to the organs and structures involved; constipation, attacks of partial obstruction, and marked diarrhoea have been reported; of these diarrhoea is the most common. Ascites and oedema may come on early, but as a rule they are terminal symptoms.

A transverse sausage-shaped tumor or a sense of resistance was reported in 13 cases. The motility of the tumor depends on the amount of peritoneal involvement. Hæmatemesis is

not common; melena rare. An increase of HCl is uncommon, a decrease or absence of free HCl is the rule. Lactic acid is present in a small number of cases.

The vomiting, at first inconstant and inconsequent, becomes more frequent; towards the last it is incessant. If the lesion be near the cardia it simulates a regurgitation from an œsophageal stricture. The vomiting is never that of a dilated stomach, but of a small rigid organ which is intolerant to the quantity of food rather than the quality. The patients complain of a suffocative tightness in the epigastrium; this distressing symptom is partially relieved by vomiting. The stomach cannot be distended and will only hold small quantities of fluid.

Valuable information can be obtained from an X-ray examination. In Jonas's case the shadow showed a small stomach of the infantile type drawn well up under the ribs, the outline of the shadow was sharp, no peristaltic wave was noted. Pressure on the stomach wall forced the bismuth paste into intestine.

*Course.*—Unrelieved by surgical measures, the disease is uniformly fatal. In 43 cases of true linitis plastica, in which the duration of the symptoms was given, the shortest was 3 months, the longest 20 years, the average 49 months. In 37 cases of the so-called malignant type, the shortest duration was one month, the longest 15 years, the average 23.9 months.

*Diagnosis.*—The diagnosis of linitis plastica is rarely made during life; it comes to light as a surprise of the operating table or the autopsy room.

Boulton (1862) reports a case in which the diagnosis of linitis plastica was made during life. At autopsy the gross findings were those of linitis plastica, but as no microscopical examination was made, the honor of the first diagnosis which was proven by autopsy and microscopical examination goes to Deguy (1896); the credit of the second goes to Osler (1901).

An accurate clinical diagnosis between scirrhus cancer and linitis plastica is impossible. After the most careful, pains-

taking microscopical examinations failure has been recorded (Curtis's case). The points in favor of its benignity are: a history of cardiac insufficiency, general arteritis, pericarditis, etc.; its occurrence in younger people; its long duration; the absence of evidences of dilatation of the stomach; the slowly decreasing capacity of the stomach; the infrequency of hæmatemesis and melena; the character of the cachexia, it being a starvation rather than a poisoning. The size, distensibility, and the presence or absence of a pyloric stenosis can be determined by the X-ray and physical means. If a small shrunken stomach without pyloric tumor formation be found, the question of a linitis plastica might arise (Jonas's case).

The condition has been mistaken for (1) movable kidney, (2) movable spleen, (3) movable transverse colon, (4) portal cirrhosis, (5) pyloric stenosis with ulcer, (6) gastric ulcer with degenerative changes, (7) chronic peritonitis, (8) tubercular peritonitis. The diffuse infiltrating hypertrophic type of syphilis of the stomach could be readily mistaken for linitis plastica. Here we would depend on the history, the results of a course of anti-syphilis treatment, and the presence or absence of the Wassermann reaction.

*Treatment.*—The practical difficulties in making a diagnosis between this lesion and scirrhus cancer, and the possibility of it being a precancerous state, make gastrectomy the operation of choice provided the technical conditions are satisfactory. The condition of the patient, the presence of extensive adhesions, etc., may make gastro-enterostomy advisable. If gastro-enterostomy is impracticable, jejunostomy in Y gives a better clinical result than gastrostomy. Marchant and Domulin describe lesions similar to those of linitis plastica, in which the patients have been apparently cured by simple exploratory laparotomy and by gastro-enterostomy.

*Total gastrectomy*—three cases.

RIBERA (1895), reported by Boeckel. Total gastrectomy with œsophago-duodenal anastomosis; well four years after. This is the first operative case on record. It was a marked case of linitis plastica with numer-

ous adhesions between the stomach and the parietal peritoneum. At operation a portion of the abdominal wall was resected, as it was thought to be infiltrated with cancer. Microscopical examination proved it to be benign. (Table A, No. 53.)

VAN LEERSUM (1900). First performed pyloroplasty (Heineke-Mikulicz), no improvement; three months later did a total gastrectomy with œsophagojejunal anastomosis. (Table B, No. 38.)

JABOULAY (1904), reported by Gayet and Patel. Total gastrectomy; rectum removed one year later for a similar lesion. (Table B, No. 16.)

*Partial gastrectomy*—thirteen cases.

MONPROFIT (1898). Resection of one-third of the stomach; gastro-enterostomy in Y. (Table A, No. 28.)

DEBÉT (1900), reported by Brissaud. Pylorectomy; well four months later. (Table B, No. 10.)

VAUTRIN (1900). Partial gastrectomy; gastroduodenal anastomosis; died two and one-half years later of acute phthisis; no autopsy. (Table B, No. 17.)

WEISS (1900), reported by Schacher. Partial gastrectomy, two-thirds. Gastroduodenal anastomosis; well two and one-half years after. (Table B, No. 13.)

CHAPUT (1901), reported by Tourlet. First gastro-enterostomy; then pylorectomy; well ten months after. (Table A, No. 30.)

PONCET, reported by Mouriquard. Partial gastrectomy with gastro-enterostomy; fourteen days after the original operation the wound broke open, gastric fistula formed; spontaneous healing; well 22 months after. (Table B, No. 19.)

ROSSI (1903). Partial gastrectomy; patient died three months later from intestinal obstruction, the result of the operation. (Table B, No. 29.)

DURET (1904), reported by Danel. Partial gastrectomy with gastroduodenal anastomosis; died three days later from shock. (Table B, No. 45.)

TASINI (1906), reported by Morone. Partial gastrectomy; well 14 months later. (Table B, No. 43.)

QUENU (1906). Pylorectomy with posterior gastro-enterostomy. (Table B, No. 25.)

QUENU (1906). Extensive gastrectomy with posterior gastro-enterostomy; died three and one-half years after. (Table B, No. 26.)

LECENE (1908). Pylorectomy with gastro-enterostomy. (Table B, No. 24.)

TEMOIN (1910), reported by Roussy. Pylorectomy. No clinical details. (Table B, No. 59.)

*Gastro-enterostomy*—nine cases.

CHAPUT (1906), reported by Chaput and Pilliet. Gastro-enterostomy; died two days later. (Table A, No. 25.)

TRICONNI (1902), reported by Cignozzi. Gastro-enterostomy in Y; died eight days later from inanition. (Table B, No. 33.)

VAUTRIN (1903), reported by Vautrin and Hoche. Gastro-enterostomy; two months later an entero-anastomosis for vicious circle; died next day. (Table B, No. 11.)

SHELDON (1903). Anterior gastro-enterostomy; well at the present time (personal communication). (Table A, No. 46.)

ROUX (1904). Anterior gastro-enterostomy; well three and one-half years after. (Table A, No. 31.)

DEAVER (1906). Posterior gastro-enterostomy; died four years after; cause of death not known (personal communication). (Table A, No. 47.)

LYLE (1907). Posterior gastro-enterostomy; well at the present time. (Table A, No. 71.)

DERVEAU (1909). Posterior gastro-enterostomy impossible on account of adhesions. Anterior gastro-enterostomy. Died of inanition four months later. This was an extreme case of linitis plastica. Derveau says he should have done a jejunostomy in Y. (Table A, No. 58.)

*Pyloroplasty*—one case. See Van Leersum. (Table B, No. 38.)

*Gastrostomy*—two cases. (a) See Jonnesco and Grossman. (Table A, No. 34.) (b) Stretton (1909). Gastrostomy; died. (Table B, No. 27.)

*Jejunostomy*—four cases.

WICKERHAUSER (1902), reported by Cackvoic. Gastrectomy indicated but impossible; jejunostomy performed; died seven days later from peritonitis. (Table B, No. 34.)

CACKVOIC (1902). Jejunostomy; died seven days later from hypostatic pneumonia. (Table B, No. 35.)

v. EISELBERG (1902). Jejunostomy (Witzel). Well five years after. Eighteen days before this operation an exploratory laparotomy had been performed with the object of making a posterior gastro-enterostomy; this was found to be impossible. The abdomen was closed as the patient's consent for the formation of an artificial fistula had not been obtained. (Table A, No. 48.)

JONNESCO and GROSSMAN (1905). A typical gastrostomy was attempted under difficult conditions; it was not satisfactory, so a jejunostomy in Y was performed. Patient improved. A few weeks later an attempt was made to close the gastric fistula. Patient died two days later. (Table A, No. 34.)

*Manual Dilatation*.—FINNEY (1901), reported by McRae. Manual dilatation for hour-glass constriction; died four days later. (Table A, No. 36.)

## CONCLUSIONS.

1. Diffuse fibrosis of the stomach occurs without cancer.
2. A large number of the cases reported are frankly cancer and have no claim to be termed linitis plastica. On the other hand, some of the cases reported as linitis plastica are



scirrhus cancers. "This is no doubt true of some of Brinton's cases, for at that period the microscopical examinations were of necessity inadequate." (Welch, personal communication.)

3. The clinical diagnosis is rarely possible and at the best is always problematic. The microscopical diagnosis necessitates a careful and prolonged search for nests of cancer cells in order to exclude scirrhus.

4. There is a possibility that the condition may be a pre-cancerous state, bearing somewhat the same relation to scirrhus cancer that gastric ulcer bears to gastric carcinoma.

5. The treatment is surgical.

#### TABLE A.—BENIGN.

##### *Abstracts of Reported Cases of Linitis Plastica.*

1. CARRIÈRE, male, age 52. Gastric symptoms for four months; no tumor felt. Autopsy; hypertrophy of the stomach most marked in the pyloric region but extending on lesser curvature and anterior wall. Microscopical: benign.

2. TROUSSEAU, male, age 25. Active gastric symptoms for three months; palpation gives a suggestion of thickened stomach wall. Autopsy: small, contracted, thick-walled stomach; no tumor. Diagnosis before autopsy: carcinoma. Microscopical: benign linitis plastica.

3. BALLET, female, age 59. For several months pain, vomiting, and tenderness; alcoholic history. Autopsy: ascites; stomach about size of transverse colon; surface smooth; no adhesions; no ulceration of the mucosa; tissue hard and grated under the knife. Microscopical: marked connective-tissue increase in the submucosa. Original diagnosis: carcinoma of the stomach; revised: benign linitis plastica.

4. MARIGNAC, female, age 29. For twenty years obstinate constipation alternating with diarrhœa; active gastric symptoms for six months; death from intestinal obstruction. Autopsy: ascites; stomach small, walls very thick, adhesions between stomach and colon; numerous small, white fibrous patches on the mesentery, peritoneum, and omentum; on rectum and colon contractions of fibrous tissue. Microscopical: lesions in the stomach, colon, and rectum similar; mucosa intact; submucosa four to five times normal thickness; muscularis hypertrophied; peritoneum thickened; seems to be a case of linitis plastica of the stomach, colon, and rectum.

5. NOTENAGEL, male, age 23. Gastric disturbances for eight years; progressive pernicious anæmia. Autopsy: pernicious anæmia with small, thick-walled stomach; tissue grated under knife. Microscopical: suppression of the gastric glands and replacement by connective tissue; muscu-

laris and submucosa greatly thickened; glands non-malignant; case of pernicious anæmia with linitis plastica of the stomach.

6. BROCA, female, age 50. Gastric symptoms for seven years; pain and vomiting; no blood; tumor in the epigastrium. Autopsy: small thick-walled stomach. Microscopical: benign.

7. SNELLEN, male, age 52. Progressive gastric symptoms for two years; tumor in epigastrium. Autopsy: hypertrophy of the submucosa. Microscopical: mucosa shows lesions of chronic gastritis; submucosa compact, fibrous infiltration; hypertrophy of the muscularis with fibrous infiltration.

8. LEUDET, male. No clinical symptoms given. This case is quoted by Tourlet, but the evidence is not sufficient to call it a case of linitis plastica.

9. SCHOCH, male, age 32. Gastric symptoms for sixteen years. Autopsy: dilatation of the stomach with hypertrophy in the pylorus. Microscopical: marked thickening of the coats, most marked in the muscularis. This case is quoted by Tourlet, but seems to be a case of pyloric stenosis with dilatation of the stomach rather than a case of linitis plastica.

10. WILKS, female, age 44. Alcoholic; no previous history is stated; present history dates back several weeks; apparently died of peritonitis. Autopsy: ascites; chronic fibrous peritonitis with numerous adhesions; omentum and colon show marked thickening; stomach small, thick-walled, and rigid. Microscopical: hypertrophy of the muscularis with marked involvement of the submucosa; peritoneum dense and fibrous; transverse colon, sigmoid, and rectum showed a similar lesion to that of the stomach; no involvement of other abdominal organs.

11. HARE, female, age 33. Moderately alcoholic; gastric symptoms for four to five years; small tumor in the epigastrium. Autopsy: small, thick-walled stomach contained only four to five ounces; numerous adhesions; on section, hard, pearly gray in color; 1.5 to 2.5 cm. thick. Microscopical: no ulceration of the mucosa and all coats including the peritoneum showed connective-tissue changes. Diagnosis before autopsy was cancer of the spleen or of the peritoneum; revised diagnosis: linitis plastica. This patient was a laundress and was in the habit of pressing the iron against her stomach.

12. NAUWERK, female, age 23. No clinical symptoms given. Autopsy: stomach fills two-thirds of the abdominal cavity; at the pylorus there is a fibrous tumor formed by the hypertrophy of the walls of the stomach and duodenum; no ulceration; no peritonitis; no glandular involvement; thickness 14 mm. Microscopical: benign.

13. HENROT, male, age 59. Alcoholic; terminal symptoms were of three months' duration; loss of appetite, and diarrhœa; ascites, œdema of extremities; no tumor, epigastric pain, or vomiting. Autopsy: volume normal; both orifices contracted; walls very thick and resistant; no ulceration; fibrous plaques on small and large intestine; mesentery and omentum thickened. Microscopical: stomach and contracted portions of the small and large intestine showed the lesions of linitis plastica.

14. DURAND-FARDEL, reported by Letulle. Alcoholic; for eight months has presented classical symptoms of cirrhosis of the liver. Autopsy: stomach sausage-shaped; walls hard and thick; cut like cartilage; omentum shrunken and hard; liver cirrhotic. Microscopical: marked case of linitis plastica. Before the microscopical examination this was thought to be carcinoma of the stomach.

15. SCHMIDT, female, age 46. Alcoholic; gastric symptoms for eight years; vomited blood once; no tumor. Autopsy: ascites; diminution in size of all abdominal organs; stomach very small; walls hard and thick; no tumor, ulceration or scars. Microscopical: mucosa showed changes of the connective-tissue type; glands obliterated.

16. HANOT and COMBAULT, male, age 45. For one year has complained of weakness and distention of the stomach; lately marked ascites and œdema of extremities; no tumor or vomiting. Autopsy: tuberculosis of the apices of the lungs; ascites; great and small omentum shrivelled up; adhesions between the pylorus, colon and neighboring structures; numerous glands; stomach small, thick walled; mucosa smooth and thick; lesions most marked in the region of the pylorus. Microscopical: non-malignant linitis plastica; glands chronic adenitis.

17. DUBUJADOUX, male, age 23. Non-alcoholic; for three months vague pains in the right hypochondrium; lately jaundice; some ascites and œdema around the ankles; no tumor. Autopsy: ascites; cirrhosis of the liver; stomach thickened at the pyloric end; mucous membrane pale and thick; marked increase in the submucosa and muscularis. Microscopical: benign linitis plastica.

18. FORMAND, male, age 38. For ten months has had dyspepsia and vomiting; lately the vomiting has assumed the characteristic of an œsophageal regurgitation; symptoms disappeared a short time before death; no hematemesis. Autopsy: stomach very small, walls hard, 2.5 cm. thick; volume 130 to 150 c.c. On the posterior wall there is an ulcer, the base of which is the spleen; the lesion was thought to be cancer, but on microscopical examination it proved to be benign linitis plastica.

19. KAHLDEN, female, age 60. Vague gastric trouble for one year and a half; vomitus contained blood during the last weeks; ascites; tumor. Autopsy: chronic fibrous peritonitis; atrophy and sclerosis of the omentum and stomach. Microscopical: diffuse connective tissue infiltration of all the walls of the stomach; the glands of the mucosa have largely disappeared.

20. VITI, male, age 68. Died with symptoms pointing to a chronic bronchitis and arteriosclerosis. Autopsy: small thick-walled stomach; no tumor; no ulcer; no stenosis of the pylorus. Microscopical: lesions of diffuse sclerosis throughout stomach; marked thickening of the mucosa; hypertrophy of the muscularis; serosa not involved.

21. ROSSINI, male, age 49. Gastric symptoms for fourteen years; vomiting for ten; no tenderness or tumor; no hematemesis. Autopsy: stomach, greater curvature reaches to the level of the umbilicus; mucosa grayish-white with black patches; a mild stenosis of the pylorus due to

hypertrophy. Microscopical: mucosa infiltrated with connective-tissue; glandular epithelium normal in some portions, absent in others, and in still others shows hyaline degeneration; some of the gland tubules are cystic. Clinical diagnosis before autopsy was chronic gastritis; stenosis of the pylorus with gastrectasis. A few days before death fibrous cancer of the pylorus. Linitis plastica.

22. ROSENHEIM, female, age 58. Symptoms for fifteen months; loss of appetite; pyrosis; nausea, tenderness, progressive emaciation, tumor and anachlorhydria, lactic acid present. Microscopical: showed a simple hypertrophy of the pyloric region; mucosa shows the lesion of an atropic gastritis. The clinical diagnosis before autopsy was pyloric cancer.

23. TILLET, male. Duration of symptoms not stated. Complains of general weakness, dyspepsia, etc., without vomiting. Autopsy: stomach dilated; walls thick and cartilaginous, peritoneum not involved. Microscopical: hypertrophy of mucosa; connective-tissue infiltration of all the walls. Linitis plastica, benign.

24. GABBI, female, age 62. Gastric symptoms for several months; pain and vomiting acute in latter stages; anachlorhydria, lactic acid present; no blood; transverse tumor. Autopsy: ascites; grayish-white plaques resembling drops of wax on parietal and visceral peritoneum; stomach small; walls thick and hard; mucous membrane thrown into folds, pale; no ulceration; glands of the lesser curvature enlarged; similar thickenings in the intestine, most marked at the ileo-cæcal junction. Microscopical: hypertrophy of all the layers of the stomach, most marked at pylorus; in the different layers the maximum change is in the submucosa. Linitis plastica, benign. Microscopical examination of the intestinal lesions shows them to be benign.

25. PILLIET, male, age 55. Symptoms for about one year; lately, constipation and vomiting; hematemesis and melena; HCl present. Operation by Chaput. Thick walled, hypertrophied stomach; gastro-enterostomy; death 48 hours later. Autopsy: Microscopical: interglandular gastritis; marked involvement of muscularis and submucosa; linitis plastica; non-cancerous. (Cornil.)

26. DEGUUY, male, age 57. Two previous attacks of acute articular rheumatism; gastric symptoms for over a year. The character of the symptoms led to the belief that this was an œsophageal condition; this, however, was ruled out by the use of a stomach tube; diffuse mass. Autopsy: small, thick walled, rigid stomach; no adhesions. Microscopical: linitis plastica, benign. (Cornil.) This is the first recorded case in which the diagnosis was made during life and sustained by microscopical examination after death.

27. PEDRAZZINI, male, age 66. Has been in the hospital a month; loss of appetite; pain in the epigastrium; transverse tumor. Autopsy: small, hard, thick-walled stomach; section cartilaginous; pearly gray in color; mucosa pale and anæmic; all coats involved; most noticeable in submucosa. Microscopical: linitis plastica, benign.

28. MONPROFIT, male, age 32. For two years pain, vomiting and constipation; movable tumor about the size of an egg. Operation: mass occupying one-third of the inferior portion of the stomach; resection of the stomach. Microscopical by Pilliet: Pseudo tumor composed of chronic inflammatory tissue, involving all the layers of the stomach.

29. HUCHARD, male, age 60. Alcoholic; chronic rheumatism; signs of atrophic cirrhosis with ascites; for six months aortic insufficiency. Diagnosis before autopsy: arteriosclerosis; stomach, sclerotic process involving all the walls; near the pylorus the lesion has a gross appearance of cancer. Microscopical: a simple sclerotic process.

30. TOURLET, from Ottenger's service, male, age 33. Gastric symptoms for eight years; progressive increase; no hematemesis; extreme constipation and diminished HCl; mass. Operation by Chaput: first, gastro-enterostomy; second, pylorotomy. Well ten months afterward. Gross and microscopical examination show it to be benign linitis plastica. Ottenger's opinion: inflammatory in nature and has chronic lymphatic oedema as its basis.

31. ROUX, male, age 33. Duration of gastric symptoms not given; felt full after meals; food did not seem to pass; later vomiting; no blood; no melena; anachlorhydria; transverse tumor. Operation: gastro-enterostomy by Roux. Hard, tube-like stomach; walls greatly thickened. Operation difficult due to adhesions and thickness of walls. Patient well three years after operation. Article excellently illustrated.

32. SMITH, female, age 34. Pain and vomiting; no tumor; small, hard, thick-walled stomach; greatest involvement region of the pylorus. Microscopical: linitis plastica, benign. Smith reports another case, but as no microscopic examination is given, it is not included.

33. A. JACOBI, male, age 60. Gastric symptoms for more than six months; vomiting for six months. Diagnosis before autopsy was cancer of the stomach. Stomach was thick-walled and shrunken to the size of the small intestine; shows a progressive contraction of the stomach and gastric hypertrophy. Microscopical: benign. (Personal communication.)

34. JONNESCO AND GROSSMAN, male, age 42. Gastric symptoms for three years; pain, vomiting and tenderness; no tumor; at 52 cm. from the teeth stomach tube encounters an obstruction; stomach will only hold from 30 to 40 c.c. Operation: a typical gastrostomy attempted under difficult conditions due to the thick, hard walls; result unsatisfactory so jejunostomy performed; on account of a leakage an attempt was made to close the gastric fistula; the patient died two days after. Autopsy: shows the peritoneum free; no adhesions; stomach irregular ovoid in shape; capacity 40 c.c.; mucosa, no ulceration; section of the stomach grates under the knife and is pearly gray in color. Microscopical: enormous thickening of the submucosa; mucosa very little changed; muscularis infiltrated with connective tissue; serosa endothelium normal; connective-tissue in the submucosa. Linitis plastica, benign. Good article with excellent illustration.

35. v. SURY, male, age 60. Was treated for cardiac disease, then a diagnosis of carcinoma of the stomach and omentum with ascites was made. Had had stomach trouble for three years but the symptoms were overshadowed by the cardiac trouble until a short time before death. Autopsy: stomach, duodenum, colon, spleen, and liver bound together by firm adhesions; stomach small and thick walled. Microscopical: shows it to be a simple inflammatory lesion. (Schrumpmagen.) Excellent article.

36. McCRAE-OSLER, male, age 48. Gastric symptoms for five years; admitted to the hospital with a diagnosis of carcinoma of the stomach; free HCl; lactic acid present; can only take a small amount of nutrition at one time. Operation by Finney. Found a small, contracted stomach with an hour-glass constriction; manual dilatation of the constriction; died four days later. Autopsy: no signs of malignancy or ulceration. Microscopical diagnosis: cirrhosis of the stomach. This is the second case on record in which the diagnosis was made during life and confirmed by microscopical examination.

37. OSLER-HENRY, male, age 42. Alcoholic history; gastric symptoms for three years; pernicious anæmia. Autopsy: marked decrease in size of stomach; pylorus thickened; cicatrix of old ulcer on lesser curvature; especially noticeable is the atrophy of the mucous membrane and the marked hypertrophy of the muscularis mucosa.

38. FENWICK, male, age 45. Gastric symptoms for eighteen months. Autopsy: linitis plastica macroscopically and microscopically.

39. FENWICK, male, age 50. Gastric symptoms two to three years; cardiac insufficiency marked. Autopsy: linitis plastica.

40. FENWICK, male, age 54. Gastric symptoms for considerable period. Autopsy: linitis plastica.

(In going over these cases of Fenwick's they seem to have a marked likeness to the lesions of severe anæmia.)

41. JONES, male, age 66. Symptoms of anæmia and cardiac insufficiency. Autopsy: benign atrophy of the stomach.

42. GELHAM, male, age 45. Gradual progressive gastric symptoms. Autopsy: Microscopical: shows a degeneration and atrophy of the gastric tubules.

43. MARCY-GRIFFITH, male, age 46. Gastric symptoms for five years; alcoholic history; can only take small amounts of food; diarrhœa. Autopsy: stomach very small; lumen contracted; holds 60 c.c.; mucosa smooth; stomach wall 1.5 cm. thick. Microscopical: mucosa very little changed; marked connective-tissue overgrowth in the muscularis; stellate cicatrix in the mucosa.

44. CHARLES, male, age 73. Gastric symptoms, vomiting and diarrhœa. Autopsy: small, thick-walled, tube-like stomach. Microscopical: linitis plastica, benign. Illustrated.

45. OLLIVER, female, age 35. Gastric symptoms for two to three years. Autopsy: ascites; stomach small; holds 100 cm.; wall 1.5 cm. thick. Microscopical: linitis plastica, benign.

46. SHELDON, male, age 52. Gastric symptoms for fifteen years, gradually increasing; anæmia severe; no free HCl; no tumor; stomach will only hold a very small quantity. Before operation a probable diagnosis of benign stenosis was made; at the operation stomach was found to be greatly diminished in size, the walls thickened, firm, elastic and resistant; walls 1 cm. thick; anterior gastro-enterostomy; patient is well at the present date, May 11, 1911, eight years after operation.

47. DEEVER, male, age 46. Gastric symptoms for three years; no hematemesis; no melena; cannot retain more than 180 cm. at a time; no free HCl; no tumor. Operation: posterior gastro-enterostomy; stomach much contracted; walls dense and fibrous, resembling in appearance the shape of the small intestine; walls 2.5 cm. thick; died four years later, cause not known. (Personal communication.)

48. VON EISELBERG, female, age 41. Gastric symptoms for three years; feeling of pressure in stomach; anorexia and frequent vomiting; stomach's contents normal; stomach only held a small amount; pre-operative diagnosis: hour-glass stomach with adhesions. Operation: stomach bound down by adhesions; looked like a long, narrow sac; the surface of the stomach between the adhesions seemed to be covered by a net-work of scars; walls were that of a rigid tube; no ulceration; gastro-enterostomy was technically impossible and gastrostomy could not be performed as patient's consent had not been obtained for the formation of a fistula; eighteen days later a jejunostomy by the Witzel method was performed; patient is well five years after.

49. HADDEN, female, age 30. Gastric symptoms for ten months; Autopsy: stomach, tube-like, 10 cm. long; walls 1.2 cm. thick; mucous membrane roughened and ulcerated at the œsophageal end, remaining portion smooth and firm. Microscopical: mucosa has disappeared; great thickening of the submucosa; muscularis and serosa normal; no sign of malignancy.

50. TURNER, male, age 60. Gastric symptoms for one month; died three months later. Autopsy: two inches from the pylorus tight stricture; walls of the stomach greatly thickened and fibrous; ulcer on the anterior wall about the size of twenty-five-cent piece; mucosa traversed by fibrous tracts; numerous peritoneal adhesions. Author states that the extreme thickness was not due to the ulcer but the ulcer was the result of the condition.

51. LEITH (Albutt's system), case of diffuse cirrhosis of the stomach. Microscopical: benign.

52. ALBUTT (Leith), male, age 40. Ten years before had been treated for ulcer of the stomach. Autopsy: non-malignant cirrhosis of the stomach. Albutt believed that the process arose from the scar of a healed ulcer; judging from the scar the ulcers had been of considerable extent and severity, resulting in a keloid.

53. RIBERA, female, age 40. Gastric symptoms for five years; pain and vomiting; free fluid in the abdomen; tumor. Pre-operative diag-

nosis: cancer. Operation: total gastrectomy; small contracted stomach with adhesions; portion of abdomen wall resected as it was infiltrated. Microscopical: chronic inflammation with the predominance of connective-tissue element; no epithelial elements; old ulcer; well four years after; non-cancerous. First operative case on record.

54. HALIPRE-BEAURAIN, male, age 60. Diagnosis of diabetes; no gastric symptoms; leucoplakial patches in mouth and on lips. Autopsy: stomach small and thick-walled; glands enlarged. Microscopical: linitis plastica, benign; glands benign. This case died of diabetic cachexia. These authors reported two other cases which were cancerous in nature. See Table B.

55. JONAS (Van Orden), female, age 41. Had abdominal cramp from youth; lately pain and vomiting; no hematemesis; anachlorhydria; trace of blood in stools; resistance in the epigastrium; thought to be cancer. X-ray was taken and showed a stomach infantile in type; no stenosis; no peristaltic waves; bismuth passes readily into the small intestine; absence of stenosis speaks against cancer. This is the first reported case in which X-ray has revealed this condition.

56. BOULTON, female, age 22. Alcoholic; gastric symptoms for three years and a half; diarrhoea is marked; tumor. Made a diagnosis during life of linitis plastica (1862). On gross examination it appears to be linitis plastica, but as no microscopical examination is given, we cannot accept it. This is the first reported case in which the diagnosis was made during life.

57. HOLAND, female, age 35. Three years ago noticed an enlargement of abdomen; tumor; indefinite gastric symptoms. Autopsy: dense, fibrous adhesions involving viscera and omentum; small, thick-walled stomach. Microscopical: benign linitis plastica.

58. DERVEAU, male. Gastric symptoms for one year; pain, distress and vomiting; no hematemesis; anachlorhydria; cachexia; an extensive mass was felt and a pre-operative diagnosis of cancer of the pylorus with extension on the anterior wall and lesser curvature was made. Operation: stomach size of kidney and felt like kidney; numerous adhesions to all the neighboring organs; anterior gastro-enterostomy made; lumen of stomach greatly reduced; walls very thick. Case improved for a time but died four months later. Microscopical: extreme case of linitis plastica; benign.

59. PHILLEPPEN, female, age 36. History was that of ulcer of the stomach; gastric symptoms for eight years; had marked hypochlorhydria; diarrhoea toward the close; died in the hospital after two months' medical care. Autopsy: Macroscopical and microscopical: linitis plastica, benign; no ulceration. Writer thinks it is most often seen in tubercular subjects.

60-61. VIILLERS reports two cases of typical benign linitis plastica complicated by tuberculosis and states that this tubercular relationship is common in this disease of the stomach.



KROMPFECHE reports on the anatomy, histology, and pathogenesis of nine cases of sclerotic stenosis of the stomach and intestinal tract.

62. Female, age 54. Death the result of a mitral stenosis. At autopsy a marked funnel-shaped stenosing hypertrophy was found; the pylorus was 7 cm. thick; on the surface of the stomach were fibrous patches; there was a similar lesion on sigmoid. The latter growth was the most marked at its mesenteric attachment. Microscopical: mucosa, nothing abnormal; muscularis mucosa, intact, œdematous; submucosa, sclerosis, hypertrophy and œdema with a characteristic obliteration of the capillaries; subserosa, peculiar calcareous deposit; circumscribed telangiectasis in the walls of stomach and sigmoid.

63. Male, age 47. Cause of death: purulent cystitis, pyelonephritis, amyloid degeneration of the kidney. There was an old fibrous pleurisy, fibrous peritonitis, an induration of spleen and pancreas and a marked funnel-shaped stenosing hypertrophy of the pylorus, dilatation of stomach and a circumscribed telangiectasis. Telangiectasis and fibrous patches in rectum. Marked hypertrophy and sclerosis of bladder and ureters. Microscopical: gastro-intestinal tract, bladder, and ureters showed a combination of hypertrophy, sclerosis and œdema with a tendency to the obliteration of the capillaries of submucosa.

64. Female, age 36. Diagnosis: cardiac insufficiency (bicuspid). Autopsy: marked arteriosclerosis, dilatation of heart, induration of lungs and liver, fibrous peritonitis, hypertrophy of pylorus and the small and large intestine, ulcer of rectum. Microscopical: marked necrosis of the atropic mucous membrane of the small intestine, a combination of œdema, hypertrophy and sclerosis of the connective tissue elements, causing a compression of blood vessels which leads to an obliteration or dilatation.

65. Male, age 79. Chronic endocarditis of the mitral and aortic valves, arterio-sclerosis, empyema of lungs; hypertrophy and stenosis of pylorus; small intestine involved. Microscopical: œdema, sclerosis and hyalin degeneration of the thickened pylorus and corresponding lesion in the small intestine.

66. Female, age 64. Arteriosclerosis, secondary endocarditis, venous hyperæmia, œdema, pyloric hypertrophy. Microscopical: mild inflammation of mucous membrane; œdema, sclerosis and hyalin degeneration of the muscularis, submucosa and serosa.

67. Male, age 49. Arteriosclerosis, secondary endocarditis, marked pyloric hypertrophy, venous hyperæmia, œdema, and atrophy of intestine. Microscopical: mild inflammation of mucous membrane, œdema, sclerosis and hyalin degeneration of the muscularis, submucosa and serosa.

68. Male, age 62. Clinical diagnosis: gastric cancer. Autopsy: general arteriosclerosis, hypertrophy of heart; interstitial myocarditis, venous hyperæmia, œdema pylorus; marked hypertrophy with stenosis; intestine œdematous, at places atrophy. Microscopical: mild inflammation of mucous membrane, œdema, sclerosis and hyalin degeneration of the muscularis, submucosa and serosa.

69. Male, age 44. Villous cancer of bladder; fatty degeneration of heart muscle; adhesive pleurisy; œdema of lungs; fibrous perihepatitis; pyloric hypertrophy. Microscopical: marked œdematous involvement of the sclerotic and hypertrophic connective tissue of stomach and small intestine.

The above cases of Krompecher's series show a benign stenosis of the pylorus; with the exception of Case 68 they were all discovered at autopsy.

Cases 62, 65, 66, 67 had non-compensating hearts with arteriosclerosis. Cases 63 and 69 had bilateral adhesive pleuritis, empyema, perihepatitis and heart weakness. Cases 64 and 68 had extensive arteriosclerosis. Ages range from 36, 42, 49, 49, 54, 62, 64, 79—5 men, 3 women.

70. Male, age 22. Died of incarceration and peritonitis. Autopsy: degeneration of heart, œdema of lungs, œdema of small intestine; chronic peritonitis, wax-like plaques on the serosa of the stomach and intestine. These plaques show a combination of hypertrophy, sclerosis and œdema; some of them show calcareous sclerotic tissue. The sclerosis is most marked in the submucosa and many of the vessels are collapsed.

From the study of this case Krompecher pictures the steps: first, a chronic venous œdema caused by cardiac insufficiency, arteriosclerosis, callus pleuritis, chronic empyema, etc., and following on this is an œdema and induration. In the literature the reports, as a rule, are confined to the stomach and do not give the lesions of the other viscera. He concludes that gastro-intestinal sclerostenosis bears a near relation to venous congestion and œdema; third, the pathological process is similar to scleroderma, begins with œdema and ends with sclerosis.

LYLE. The patient, B. B., was transferred from the medical service of Dr. Janeway to the surgical service of Division B, St. Luke's Hospital.

*Diagnosis.*—Partial volvulus of stomach with abdominal adhesions.

Admitted June 11; transferred to surgical side, July 23, 1907.

*History.*—Woman, single, aged forty; Swede, occupation, cook.

*Family History.*—Father had kidney trouble and rheumatism. Three children had rheumatism, two had cardiac complications; third attack two years later, in bed five weeks; last January was in bed three weeks with an attack of rheumatism. This was followed by an otitis media, which lasted four weeks. Has nocturnal dyspnoea, suffers from pain, palpitation, dizziness, and syncope. Menses irregular and painful. No history of syphilis.

*Present History.*—Five days ago had sharp, cramp-like pains in the left lumbar and inguinal regions, radiating downward and inward into the thigh. These pains persisted for three days, then disappeared, to reappear on the second day after; felt nauseated, but did not vomit. These attacks came at irregular intervals and bore no relation to the taking of food. Complained of tenderness at a point just to the left of umbilicus.

Urination: Some increased frequency, somewhat cloudy; otherwise negative. Bowels constipated, appetite poor.

*Physical Examination.*—Patient, woman, weight 98 lbs.; large frame; poorly nourished; skin and mucous membranes anæmic; tongue clean.

Pulse: Irregular and of poor force.

Heart: Apex in sixth space,  $4\frac{1}{2}$  inches to left; action somewhat irregular. There was a harsh, blowing, systolic murmur heard at the apex; a second one heard over the pulmonic area. Second pulmonic accentuated; right border one inch to the right.

Lungs: Clear.

Abdomen: Tenderness and slight muscular spasm one inch down and to the left of the umbilicus. No mass made out. Liver enlarged. Spleen not felt. Right kidney palpable. Rectal and vaginal examination negative.

Extremities: Superficial glands enlarged.

Blood: Leucocytes, 11,532; polynuclears, 74 per cent.; lymphocytes, 26 per cent.; hæmoglobin, 70 per cent. Urine normal.

Patient was examined in hot bath, and a sense of muscular resistance was experienced in the upper left quadrant.

Tuberculin injected. No reaction.

June 12: Patient still complained of severe attacks of pain in the epigastric region, had several attacks a day—no relation to the taking of food.

June 19: Attacks of pain continued—several every day. At times the pain radiated upward into the left axilla and across the abdomen. The attacks grew more severe.

Stomach analysis, June 4, 1907: Total acidity, 56; free HCl, 20; no lactic acid; no Boas-Oppler bacilli; no blood.

As the condition was steadily growing worse, she was trans-

ferred to the surgical side for operation, the diagnosis being gastric adhesions.

Operation by Dr. Lyle, July 27, 1907. On opening the abdominal cavity a mass of adhesions was encountered and the exact relation of the parts could not be made out. On separating the adhesions, it was found that the stomach was half rotated to the left, and the pylorus was firmly fixed by a short, dense, fibrous band to abdominal wall one inch and a quarter to the left of the umbilicus; there was a corresponding twist in the great omentum. The stomach itself was about half the size of a fist, puckered, and scarred. Over the region of the pylorus and lesser curvature the wall was markedly thickened and congested, suggesting a possible old ulcer or a new growth. A portion of tissue was removed for examination. Glands enlarged. It was decided to shorten the gastrohepatic ligament to prevent the recurrence of the rotation, and to do a gastro-enterostomy. During the shortening of the ligament, the patient's condition became serious, so the gastro-enterostomy was abandoned and the abdomen closed. The patient was returned to the ward. From the second day on she made an uninterrupted recovery. She left the hospital on the fifteenth day, apparently cured of all her symptoms.

The examination of the tissue removed showed granulation tissue, young connective tissue with areas of chronic inflammation. Nothing pointing to malignancy. Patient was seen eight months later, when she appeared to be well and strong.

Patient was again admitted to the hospital August 20, 1908.

*History.*—Since leaving the hospital she has been perfectly well, provided she limits her food in quantity. The quality does not seem to make any difference. Five weeks ago began to vomit half an hour after eating. The ingestion of food causes considerable pain, which pain is referred to the old scar. The patient can take only small quantities of food. Pain is sharp and cramp-like in character and radiates down the left leg to the knee; has gradually grown worse, and is very severe at the present time. Some burning in throat and eructations of gas. Has lost 25 lbs. in 8 months. Has grown quite weak. Occasional attacks of dizziness; no symptoms of loss of cardiac compensation. Stomach contents show a slight increase of total

acidity and free HCl on the first examination; the second a loss of acidity and free HCl.

Abdomen: Concave, soft, and relaxed. There is a firm linear scar, three inches long, half way between ensiform and umbilicus. Some tenderness in the epigastric region. No mass made out. Outline of stomach could not be mapped out. Six ounces of water distended the organ and gave considerable distress.

*Diagnosis.*—Possible gastric adhesions. With the previous history in view, it was thought advisable to place the patient under medical treatment for gastric ulcer before proceeding to operation. Patient put on Lenhart's regimen. There was no improvement.

Operation September 9, 1908. Dr. Lyle.

On opening the abdominal cavity, a small, shrunken, and scarred stomach was found covered with adhesions—some of these dense, others thin; they extended from the anterior surface to the abdominal wall and from the lesser curvature to the under surface of the liver. The lesser curvature was represented by a dense, scar-like mass, radiating from which were folds of thickened tissue and adhesions. The distance from the pylorus to the œsophageal opening, measured along what remained of the lesser curvature, was less than one-half inch. The stomach was contracted to about the size of a goose egg, and was almost circular in shape. The stomach wall seemed to be twice the normal thickness.

A no-loop posterior gastrojejunostomy was performed; considerable difficulty was experienced, due to the smallness of the stomach and the thickness of its walls. The patient made a prompt and rapid recovery and was out of bed on the thirteenth day.

Since leaving the hospital she has been under careful observation, and is well and strong. Has gained 35 lbs., and worked steadily since leaving the hospital. The stomach contents still show a diminished acidity.

At the first operation the condition was not recognized, and it was thought to be a case of ulcer of the stomach with the formation of numerous perigastric adhesions, accompanied by accidental rotation of the stomach. The walls of the stomach at

that time were thickened and scarred. The freeing of the adhesions and shortening of the gastrohepatic ligament gave relief for almost a year.

At the second operation the uniform increased thickness of the walls and the marked diminution of the size of the stomach, plus the scarring, showing that something else than a contraction following a simple ulcer had to be dealt with. In the causation of this case we have a combination of two factors, each of which have been given as a cause of the disease. We have a well-marked history of chronic passive hyperæmia from cardiac insufficiency (the result of repeated attacks of rheumatism), and a strong possibility of multiple peptic ulcers. The chronic condition, plus the irritation set up by the ulcers, would undoubtedly be a sufficient stimulus to start changes in the connective-tissue elements of the stomach, and thus lead to marked general contraction; with the contractions would come of necessity a thickening of the walls, until we find a rigid organ with greatly diminished lumen and thickened walls, as found in this case.

NOTE.—Since the preparation of this report the patient has had four distinct attacks of toxic erythema, due to the taking of meat. These attacks can be controlled by the addition of some dilute HCl and pepsin, showing that her stomach digestion is below par for digestion of meats.

#### TABLE B.

##### *Cases Reported as Linitis Plastica which are Malignant in Nature.*

1. WEIL. T. G., male, age 61. Two months before entering hospital noticed a tumor in pyloric region; tenderness; regurgitating vomiting; died of purulent pleurisy. Cachexia was a very prominent symptom. Autopsy: stomach wall is 2.5 cm. thick; mucosa normal; submucosa was replaced by a hard, dry tissue which furnished no juice on scraping; head of pancreas and prevertebral glands invaded; peritoneum not involved. Microscopical: mucosa a little invaded by new growth; muscularis destroyed; submucosa makes two-thirds of the thickness; considers this a new plastic growth similar to a fusiform sarcoma.

2. LYONNET, female. Symptoms for ten months. Autopsy: enormous diffuse thickening of the whole stomach; secondary deposits in the pancreas and heart; ascites; enlargement of the glands. Microscopical: malignant linitis plastica.

3. BEZANÇON, male, age 41. Alcoholic; symptoms for a year; vomit-

ing quarter of an hour after eating; pain. Autopsy: stenosis of the pylorus formed of sclerotic tissue; no ulceration; stomach somewhat dilated. Microscopical: a typical epithelioma (Bezançon). Chronic inflammation without cancer. (Cornil.)

4. TILGER, female, age 35. Progressive gastric symptoms for two years; induration of pylorus; stomach dilated. Autopsy: marked stenosis of the pylorus; stomach walls thick. Microscopical: all coats hypertrophied; submucosa most marked; between connective-tissue there are masses of epithelial cells denoting cancerous degeneration; mucosa shows the lesions of chronic gastritis. (Plates with detailed examination.)

5. BRET-PAVIOT, female, age 43. Alcoholic; insidious onset beginning four years before; last eighteen months has had attacks of colic and diarrhœa; persistent vomiting; no hematemesis; no melena; stomach tube appeared to stop at the cardia; tumor. Autopsy: ascites; stomach white in color, cylindrical with the calibre of the colon, two-thirds of its extent involved; numerous adhesions; similar lesion in colon; two tumors on ovary, possible cancers or fibro-myomata. Microscopical: all coats show connective-tissue infiltration, the maximum being in the submucosa; epithelial cells are found here and there. Examination of an ulcer in the cardiac region shows it to be non-cancerous. This is classed by Tourlet as benign but it is undoubtedly malignant.

6. LEPINÉ, cit. by Bret-Paviot, female, age 49. Progressive gastric symptoms for two years; diarrhœa and vomiting at close; no hematemesis; no melena. Autopsy: small, thick-walled, adherent stomach; section is pearly white in color and grates under knife; glands of the lesser curvature involved. Microscopical: mucosa lymphoid hyperplasia; submucosa infiltrated with undulating connective-tissue fibres in the meshes of which are epithelial cells. This is quoted by Tourlet as being benign but is undoubtedly malignant.

7. PILLIET-SAKORRAPHIS, male, age 31. Pain in the right side; loss of appetite; ascites; thought to be a cirrhosis or tubercular peritonitis; patient never vomited; died three years and a half after onset. Autopsy: stomach about the size of the closed fist; walls thick and hard; numerous adhesions; mucosa thickened; no ulceration. Microscopical: all coats of the stomach equally involved; embryonal infiltration at the pylorus; at greater curvature the mucous membrane is thinned; numerous round and fusiform cells present; the muscularis mucosa has disappeared; submucosa connective-tissue, infiltration with fusiform cells; vessels show endoarteritis; the colon presents similar lesions. Tourlet classifies this as a benign case.

8. PETIBON, male, age 54. Has had indefinite gastric symptoms for years; symptoms of chronic gastritis for six months; tumor. Autopsy: small, thick-walled stomach; œsophagus involved; glands enlarged. Microscopical: linitis plastica, cancerous.

9. VERHOEGHE, male, age 60. Gastric symptoms for more than a year; regurgitation is marked; alcoholic. Autopsy: shrunken, rigid stomach

resembling coil of small intestine. Microscopical: cylindrical epithelioma with connective-tissue infiltration: linitis plastica, malignant.

10. BRISSAUD (Tourlet), male, age 34. Alcoholic; lues six years previously; gastric symptoms for a year; vomits immediately after taking food; lately vomiting has become incessant; stomach is not dilated; tumor in the region of the pylorus; no hematemesis; no melena. Operation: pylorotomy by Debét. Pre-operative diagnosis: chronic gastritis with fibrous stenosis of the pylorus. Portion removed at operation shows a neoplasm in the form of a cylinder 6 cm. long; consistency of the walls recall a fibroma or myoma. Microscopical: by Monod. This is quoted as benign by Tourlet. Schacher says it is a typical epithelioma. P. 77. Patient well four months after.

11. VAUTRIN-HOCHE, male, age 29. Gastro-enterostomy; two months after operation patient returned, suffering from a vicious circle; entero-enterostomy performed; death the following day. Stomach small, thick walled; retroperitoneal adhesions. Microscopical: diffuse epithelioma appearing in the zone of an old ulcer.

12. SCHACHER, service of Brissaud, female, age 55. Active gastric symptoms for five months; patient had had pains in the epigastrium for six years but had attributed them to her occupation which necessitated pressing with a heavy iron; constipation is marked; she had a total abdominal hysterectomy performed; both ovaries showed cysts. Operation gave no relief. Autopsy: stomach presents a hard, rigid, annular thickening; numerous adhesions; colon adherent to stomach, gall-bladder invaded by new growth; stomach adherent to posterior abdominal wall; cæcum involved at the base of appendix; sigmoid and rectum also show cancerous invasion. Microscopical: shows it to be a gastric tumor localized in the lesser portion of the stomach with anterior and posterior peritoneal adhesions. Schacher considers this a linitis plastica of cancerous nature. The course of the tumor has terminated in a generalization of the disease showing that the linitis plastica was a malignant cancer of epithelial origin. Excellent article, well illustrated.

13. WEISS (Schacher-Boechel), female, age 50. Gastric symptoms for several years; tumor. Operation: partial gastrectomy. Weiss thought it to be pure linitis plastica. Microscopical examination was made by Hoché. There is some doubt about the diagnosis of linitis plastica as an epithelial infiltration was found at the site of the old ulcer. This appears to be a diffuse infiltration of typical epithelial elements in the sclerotic inflammation of the cicatrix of an old ulcer; possibly this is a cancer developing on an old ulcer(?). This case is reported by Boechel as being well two years and a half after. (Boechel, p. 162, No. 38.)

14. SPILLMANN (Schacher), male, age 47. Gastric symptoms for one year; stomach not enlarged; no tumor; death from cachexia. Autopsy: lesions of linitis plastica most marked in pyloric region. Microscopical: diffuse neoplastic infiltration of an epithelial type in the sclerotic tissue.

15. WEISS, male, age 32. Died shortly after admission to hospital of



apparent cancer of the stomach; pylorus admitted little finger; antrum occupied by a tumor about the size of half a mandarin; stomach wall hard, pearly white in color; retroperitoneal "callus"; mesenteric and duodenal plaques. This is a case of epithelial linitis plastica type, having its origin in an old ulcer.

16. GAYET-PATEL, female, age 44. Gastric symptoms for eight months; no dilatation; no stasis; diffuse tumefaction in the region of the pylorus; free HCl absent. Total gastrectomy by Jaboulay. Stomach movable; pylorus hard and thickened; mottling and cloudiness of peritoneum; in the mucous membrane, near the pylorus, is a small erosion. Microscopical: evidence of connective-tissue in all layers; here and there cells of an epithelial character. Probably inflammation started from a cancerous base. One year later rectum was removed; it showed a recurrence. (Bret-Paviot.)

17. VAUTRIN, male, age 29. Gastric symptoms; vomiting; no hematemesis; pyloric tumor; partial gastrectomy. Patient died two years and a half after of acute tuberculosis; there were no signs of a recurrence. At the first examination two years and a half before there were no cancerous elements; a later examination showed suspicious cells in the connective tissue stroma indicating an epithelial degeneration. Boechel, p. 95. Schacher says it was linitis plastica of epithelial type. Final conclusion—scirrhus epithelioma of glandular origin.

18. CURTIS showed the stomach, ileum and colon as examples of linitis plastica, benign. On account of the protest he went over the sections again and found a small area which was cancerous. (Neurofibromatose carcinomateus.) "There exists in this case a very systemic propagation of the cancer cells following the tracks of the nerves." No clinical symptoms given.

19. MOURIGUAND, male, age 28. Gastric symptoms for eighteen months; tumor at the pylorus; stasis; free HCl; partial gastrectomy. (Poncet.) Well twenty-two months after. Diagnosis of linitis plastica was made (Paviot); there were signs of an old ulcer. Microscopical: hypertrophy of glandular region; glands non-cancerous; infiltration of submucosa and muscularis by a new production of connective tissue. Paviot considers these cells to be of neoplastic nature.

20. MOUISSET-CHALIER, male, age 71. Gastric symptoms for two years; pain on pressure; sense of resistance in epigastrium; no hematemesis. Autopsy: small, rigid, tube-like stomach; numerous peritoneal adhesions; cut section pearly white; no ulceration in mucous membrane; no tumor; cancerous mass in liver. Microscopical: linitis plastica, cancerous.

21. MÉNARD, female, age 53. Gastric symptoms for two years simulating a stenosis of the œsophagus; smooth tumor in the epigastrium; intestinal paresis; cachexial death. Autopsy: cancerous infiltration of the stomach, omentum and mesentery. This does not seem to be a case of linitis plastica but rather a case of carcinoma of the stomach.

22. FAROC, male, age 41. Vague gastric symptoms for one year; clinical course that of cancer. Autopsy: cancerous linitis plastica of the stomach;

neoplasm starting in the mucous membrane of the pylorus and extending to the abdominal walls. Patient had a neoplasm in the breast. No diagnosis is given other than that there were nodules in the skin. This looks like a recurrence after a breast tumor and not linitis plastica.

23. LORRAIN, male, age 55. Gives the symptoms of pyloric obstruction. Autopsy: linitis plastica, cancerous.

24. LECENÈ, male, age 50. Presents cancer of the pylorus with stenosis; stomach intolerant of food; anachlorhydria. Operation: pylorotomy; stomach small, rigid and tube-like. Microscopical: carcinomatous cells found in the mucosa and in the neighboring lymphatic; involvement most marked in submucosa and muscularis.

25. QUENU, male, age 32. Gastric symptoms for four years; transverse mass in the epigastrium. Diagnosis: carcinoma of the pylorus. Operation: partial gastrectomy. Gross findings those of linitis plastica. Microscopical: shows it to be cancerous in nature.

26. QUENU, female, age 28. Gastric symptoms for less than a year; epigastric tumor. Pylorotomy. No adhesions. Gross: had the aspect of scirrhus cancer. Microscopical: linitis plastica, malignant. Died three years and a half after.

27. STRETTON, female, age 56. Symptoms for three months which were supposed to be due to a cancer of the œsophagus. Gastrostomy was done. Stomach was hard, thick walled and contracted; capacity about one and a half ounces. (Leather bottle stomach.) Microscopical: shows it to be a spheroidal cell carcinoma.

28. ROSSI, male, age 50. Clinical diagnosis cirrhosis of the liver. Autopsy: Gross: appearance is that of linitis plastica with adhesions; stomach is small and drawn up under the ribs; perisplenitis and perihepatitis. Microscopical: mucous membrane shows evidence of an old tubercular inflammation in the muscularis mucosa; the submucosa shows a great enlargement due to connective-tissue in which are found some cellular fusiform elements of epithelial nature. He does not consider them cancerous; gland parenchyma not affected; capillaries invaded by epithelial elements similar to those of the gastric wall. This appears to be linitis plastica of a cancerous nature. Note: *possible tubercular influence*.

29. ROSSI, female, age 20. Symptoms for five months; tumor; no free HCl, blood or lactic acid. Operation: partial gastrectomy. Gross: linitis plastica; no ulceration; cylindrical, thick-walled sac; glands enlarged. Died three months later of intestinal obstruction. Microscopical: linitis plastica, cancerous.

30. TESTI-ZACCARIA, male, age 50. Gastric symptoms for ten months; alcoholic; vomiting; had characteristics of cancer. Gross: linitis plastica. Microscopical: scirrhus carcinoma; nature could not be accurately determined. The author has no doubt that this is an epithelial form of a scirrhus cancer.

31. CARDI, female, age 32. Gastric symptoms for two years; vomiting; HCl absent. Microscopical: linitis plastica without adhesions; lesions occupy pyloric half; on surface are white, fibrous plaques. There is a

possibility of old ulcer. Microscopical: high grade of linitis plastica with scirrhus cancer.

32. CIGNOZZI, male, age 61. Clinical diagnosis: hepatic cirrhosis with ascites; no direct gastric symptoms; intense diarrhœa; ascites and œdema of lower extremities. Autopsy: ascites; thickened posterior wall; waxy looking deposits on parietal peritoneum; thickened gastric wall with nodules; nodule in the lung; heart showed myocarditis with cardiac insufficiency; chronic tuberculosis of right pulmonary apex. Cause of death, acute perforating peritonitis. This seems to be a case of scirrhus cancer having its origin in the glandular elements. Cignozzi classes this case as a primary retroperitoneal endothelioma with secondary nodules in the stomach and left lung.

33. CIGNOZZI, female, age 38. Gastric symptoms for fifteen years; dilated stomach; tumor in the pyloric region. Operation: Gastro-enterostomy (Triconni); pylorus the seat of an annular tumefaction which extends from the pylorus to the posterior wall and greater curvature. Died eight days later. "Probable linitis plastica of endothelial type. The form of the cells, the arrangement of the alveoli and tubules, the absence of any epithelial elements exclude a cancerous process and point to an endothelial neoplasm."

34. CACKOVIC, male, age 36. Lung symptoms for two years; gastric symptoms of long standing; stomach held 100 c.c.; no tumor. Operation: jejunostomy. (Wickerhauser.) Gross: typical linitis plastica. Gastrectomy indicated but technically impossible so jejunostomy was done. Died from peritonitis seven days later. Microscopical: showed it to be cancerous.

35. CACKOVIC, male, age 60. Gastric symptoms for six months; sense of resistance at pylorus; stomach holds 50 c.c. Operation: stomach small, thick walled; presents a tumor about the size of an apple; numerous adhesions. Jejunostomy. Patient died seven days later from hypostatic pneumonia. Diagnosis: linitis plastica, malignant.

The diagnosis in the above two cases was made during life. In reading them over they seem to be nothing more than scirrhus cancers.

36. SCOTT reports a case non-malignant stenosis of the pylorus and duodenum; the pathological findings make it doubtful whether this case should be admitted.

37. POLLOCK, female, age 49. Gastric symptoms for two years; sense of resistance in the pyloric region. Autopsy: shrunken stomach, thick walled; thought to be cancer but careful examination shows no ulceration or malignancy; there seemed to be some doubt in Quain's mind so it is placed in the malignant list.

38. VAN LEERSUM-ROLGENS, female, age 22. Gastric symptoms for years; anachlorhydria. Operation: marked stenosis of the pyloric region, extending into the duodenum; pyloroplasty failure; three weeks later gastrectomy. Gross: showed specimen of linitis plastica arising from an old ulcer. Microscopical: epithelial elements found; malignant.

39. FOLLI-BERNARDELLI, male, age 60. Gastric symptoms for ten

months; no hematemesis. Autopsy: Gross: linitis plastica. Microscopical: linitis plastica, cancerous type; involvement of glands.

40. FOLLI-BERNARDELLI, male, age 62. No clinical history. Autopsy: Gross: linitis plastica; no ulceration. Microscopical: linitis plastica, cancerous.

41. FOLLI-BERNARDELLI, male, age 47. Gastric symptoms for one month; vomiting with small traces of blood; tumor in the epigastrium; ascites. Autopsy: very small, thick-walled stomach adherent to diaphragm and pancreas; mucosa pale; no ulceration. Microscopical: submucosa greatly thickened; contained abundant cellular elements; the epithelial cells had coalesced, forming small centres and infiltrating the neighboring tissue; glands enlarged; linitis plastica, cancerous.

42. FOLLI-BERNARDELLI, male, age 79. No clinical history; complete involvement of the stomach which was shrunk, thick walled and cartilaginous to feel; mucous membrane smooth; no ulceration; glands involved. Microscopical: marked increase in connective-tissue elements with infiltration of epithelial cells. Linitis plastica, cancerous.

43. MORONE, female, age 46. Gastric symptoms for eighteen months; tumor in the epigastrium; marked anæmia; hypochlorhydria; hematemesis. Pre-operative diagnosis: cancer of the lesser curvature developing on an old ulcer with secondary involvement of the pylorus. Operation by Tasini. Partial resection; linitis plastica of half the stomach; glands not involved. Patient well fourteen months after. Microscopical: linitis plastica (epithelioma).

44. RIVET, male, age 52. Gastric symptoms for two months; alcoholic; no hæmatemesis; no melena; no tumor. Autopsy: tuberculosis of the lungs; stomach contracted and adherent. Microscopical: linitis plastica, cancerous. The interest in this case is that there were no symptoms until two months before death.

45. DANIEL, female, age 34. Gastric symptoms for two years; alternating diarrhœa and constipation; no distention; no definite hematemesis or melena; marked cachexia; transverse cylindrical tumor. Diagnosis: epithelioma of the pylorus extending to the greater curvature. Operation: partial gastrectomy (Duret). Patient died three days later of shock. Autopsy: stomach small, shrunk and thick walled; omentum thickened and covered with whitish plaques; glands enlarged; no adhesions. Microscopical: linitis plastica, cancerous.

46. DUPLANT, male, age 73. No clinical symptoms. Autopsy: showed a greatly shrunk stomach covered by a thickened serosa; the thickened pylorus gave the appearance of a neoplasm; it is a diffuse neoplastic infiltration of the stomach with ulceration of the mucous membrane; glands enlarged. From gross examination the diagnosis lies between benign linitis plastica and a diffuse epithelioma. Microscopical: sections were not given at the time of the report.

47. MARIE. No clinical history; no data as regards autopsy. Statement is made that it is linitis plastica of a cancerous type.

48. MARIE. No clinical history. Autopsy: small, hard stomach with a retroperitoneal callus; no visible tumor; small ulcer near the pylorus; linitis plastica, cancerous.

49. LORRAIN, male, age 55. In the hospital for a short time with symptoms of stenosis of the pylorus. Autopsy: small, thick walled, contracted stomach. Microscopical: linitis plastica, cancerous.

50. BABES-MIRONESCA describe a case in which the gross findings somewhat resemble a linitis plastica but the microscopical examination shows it to be a gelatinous carcinoma.

51. HALIPRÉ-BEAURAIN, male, age 54. Alcoholic; gastric symptoms for eight months; no solid food tolerated; small tumor. Autopsy: stomach shrunk; feels like a rubber cylinder; middle of the transverse colon shows a fibrous ring; fibrous patches on the small intestine; glands enlarged. Microscopical: linitis plastica, cancerous.

52. HALIPRÉ-BEAURAIN, male, age 72. Rheumatic; no gastric symptoms; diarrhoea. Autopsy: stomach resembles a segment of the small intestine; greater curvature measures 6 cm.; walls very thick and resistant. Microscopical: linitis plastica, malignant. There were no gastric symptoms in spite of the advanced pathological condition. The patient died of bronchial pneumonia.

53. DELAMARE-BRELET, male, age 63. Alcoholic; gastric symptoms for four years; ascites and œdema of the lower extremities; alternating diarrhoea and constipation; the symptoms seem to be those of cirrhosis. Autopsy: ascites; liver small; mass of adhesions involving gall-bladder, greater and lesser omentum, etc.; stomach small, thick walled; holds only 150 cm.; 10 to 15 mm. thick; glands hard and small. Linitis plastica of an epitheliomatous nature.

54. FAROY, female, age 41. A few indefinite gastric symptoms before entering hospital; vomiting and progressive cachexia; death three months and a half after entering. Autopsy: small, contracted, thick-walled stomach; circular infiltration extending from the greater to the lesser curvature and making an hour-glass contraction; small intestine involved; suspicious nodules in the skin; numerous adhesions to the neighboring organs.

55. COVA-BONS, age 64. Died at 70. Symptoms recurred several times. First diagnosis was diffuse carcinoma of the stomach; second, linitis plastica with pyloric stenosis(?). Sense of resistance in the epigastrium; anachlorhydria; lactic acid present; cachexia marked. Autopsy: linitis plastica, cancerous.

56. ROUSSY presents before the Anat. Soc. of Paris four specimens of linitis plastica, in which the cancerous nature is evident from the histological examination. Two are of the generalized form and two of the localized.

Female, age 61. Linitis plastica, generalized. Short time in hospital and died of profound cachexia. No diagnosis was made. Stomach small,

hard and retracted under the liver; marked thickening of the coats; lesser and greater omentum involved; large and small intestine not involved; no secondary deposits of the viscera; lymphatic glands hard. Microscopical: grayish white; no ulceration. Histological examination shows it to be linitis plastica, cancerous.

57. Male, age 65. Linitis plastica, generalized. Stomach small, thick walled; 2 cm. thick at pylorus; large part of the transverse colon involved, 10 mm. thick; numerous adhesions; no ulceration of mucous membrane; no ascites. Microscopical: linitis plastica, cancerous; perivascular sclerosis marked in the submucosa.

58. Linitis plastica, localized. Cancerous; limited to the pyloric region. Pre-operative diagnosis: stenosis of the pylorus. Operation: gastrectomy. Small, thick-walled stomach; no evident involvement of the peritoneum. Microscopical: linitis plastica, cancerous.

59. Linitis plastica, localized. Limited to the pylorus. Operation: pylorotomy by Temoir of Bourges. Small, thick-walled stomach; pylorus 28 mm. thick; mucous membrane healthy. Microscopical: linitis plastica, cancerous.

60. LENORE-COURCOUX described a case under the title of "septicémie cancéreuse secondaire" in which the examination of the local lesion in the stomach suggested a linitis plastica of a cancerous type.

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## EXTENSIVE REMOVALS OF INTESTINE.

REPORT OF A CASE OF RECOVERY AFTER RESECTION OF TEN FEET EIGHT INCHES OF THE ILEUM.

BY J. DAWSON WHITALL, M.D.,  
OF PHILADELPHIA.

DA COSTA says ("Modern Surgery," 801) that the removal of more than six and two-thirds feet of gut will produce nutritional disturbances in an adult; that a child tolerates relatively larger amounts resected than an adult. Dressman reported 26 cases in which more than 3 feet 3 inches were removed, while Alexander Blaney (*Brit. Med. Journal*, Nov. 16, 1901) adds seven cases from literature and says that in nine of the 33 cases death occurred soon after operation. The late Nicholas Senn claimed that a third of the intestine was the extreme limit to be excised without inanition following. Roswell Park (*Buffalo Med. Journal*, Apr., 1903) reports the following resections in which over 6 feet 6 inches of intestine were removed, to which I have added the case herein reported.

OPERATOR	AMOUNT REMOVED	RESULT
(1) Koeberle .....	6 ft. 10 in.	Recovered.
(2) Kocher .....	6 ft. 11 in.	Recovered.
(3) Dressman .....	7 ft. 2 in.	Recovered.
(4) Shepherd .....	7 ft. 9 in.	Recovered.
(5) Kukula .....	7 ft. 9 in.	Recovered.
(6) Harris .....	7 ft. 10 in.	Recovered.
(7) Hayes .....	8 ft. 4½ in.	Recovered.
(8) Peck .....	8 ft. 5½ in.	Recovered.
(9) Lawers .....	8 ft. 9 in.	Recovered.
(10) Roswell Park .....	8 ft. 9 in.	Recovered.
(11) Payr .....	9 ft. 0½ in.	Recovered.
(12) Maydl .....	9 ft. 4 in.	Died three weeks later.
(13) Fantino .....	10 ft. 4 in.	Recovery.
(14) Monprofit .....	10 ft. 4 in.	Recovery.
(15) J. D. Whittall .....	10 ft. 8 in.	Recovery.
(16) Ruggi .....	11 ft. 0 in.	Recovery.
(17) Von Eiselsberg .....	11 ft. 8 in.	Died 25th day.
(18) Obalinski .....	12 ft. 2 in.	Died.

Several elements enter into the prognosis of these cases:

1. *The amount of gut left after the resection is variable*, as the entire bowel may vary from 15 feet 6 inches to 31 feet 10 inches (Treves). The length of the jejunum is about 8 feet or two-fifths of the small bowel; the ileum about 12 feet or three-fifths of the small intestine; the colon about 5 feet.

2. *The location of the portion removed*; the nearer the resection is done to the stomach the more serious the outcome, the most dangerous in order being duodenum, jejunum, ileum and lastly colon.

3. *Whether there has been fecal contamination of the peritoneum*; cases of course that have a rupture of the bowel and fecal extravasation have less chance of recovery because of the resulting septic peritonitis.

4. *Age and physical condition of the patient* has a great deal to do with the convalescence; the old bearing resection badly, while the reverse is true in the young. Patients who are suffering from malignant disease (sarcoma or carcinoma), who are tuberculous, who are generally "run down" have less chance of recovery.

AUTHOR'S CASE.—M. G., female, married, white, aged twenty-three years. About one year ago was confined; labor normal, but had a portion of the placenta retained, which later caused a pronounced sepsis. After a rather stormy convalescence (following a curettement) she finally recovered, but always complained of pain at the brim of the pelvis on the left side. This pain was often agonizing, causing her to faint several times. She last saw her menses four months ago, and considered herself normally pregnant. Symptoms of a detached placenta intervened, but she ran no temperature. On July 10, 1911, she had a convulsion (had had albumin and casts in the urine for some time) and was admitted to the Northwestern General Hospital. She was hurriedly prepared for a curettement by another physician. The placenta was immediately over the os uteri and came away easily, while portions of a macerated fœtus (four months) were gradually removed. Then a portion of tissue was grasped and pulled down, when it was seen to be bowel.

Up to this time I had not seen the patient; she had been under ether two hours, but was in fairly good condition. The abdomen was hastily scrubbed up. A four inch incision was made in the median line and the uterus exposed; the gut was seen protruding from a perforation on the left anterior portion of the fundus uteri. The bowel was gently withdrawn from the uterus; it was then seen that the mesentery supplying that portion of the gut had been entirely stripped of its connection with the bowel. There was little if any bleeding from the mesentery (the vessels having retracted and clotted). The bowel was not torn or opened at any point. All the intestine that had no mesentery was resected; both ends were ligated, stumps touched with carbolic acid then alcohol; the ends invaginated with a purse-string suture. A lateral entero-enterostomy was then done. The torn mesentery was then whipped over and over with a continuous No. 3 chromic gut suture for its entire length. The distal end was about five inches from the cæcum. The hole in the uterus was then closed with a mattress suture. The abdomen was closed in layers.

The belly was filled with a quart of hot saline solution, while drainage consisting of a rubber tube was placed in the lower angle of the wound to the anastomosis; four pieces of plain gauze (two to the cul-de-sac and one to each side). Sterile dressings were applied. Time of operation was  $1\frac{1}{2}$  hours, making a total of  $3\frac{1}{2}$  hours under ether. During this time she was given  $\frac{1}{30}$  gr. strychnine sulphate twice, and was very slightly shocked. Within fifteen minutes after she was put to bed she had reacted and was out of ether.

The specimen of gut removed was then measured in the presence of the physicians present and was found to be 10 ft. 8 inches.

The patient was placed on saline solution, after the method of Murphy, and given morphine sulphate gr.  $\frac{1}{4}$ . She had surprisingly little discomfort during her entire convalescence. The drainage was profuse and the wound had to be dressed daily. The Murphy treatment was discontinued after 48 hours. On the fourth day a triplex enema was given with very good result. For several days after, patient moved the bowels normally and passed a large amount of gas. Medication consisted of strychnine sulphate, gr.  $\frac{1}{30}$  t.i.d. Nourishment was given every two hours—albumin water and broths for the first week, then soft diet,

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and, after the nineteenth day, general diet. The drainage tube was gradually removed each day and a portion cut off, as was the gauze packing. All drainage was out by the eighteenth day, the wound cavity containing nothing but serum. The other portion of the incision healed by first intention. Patient left the hospital on the twenty-sixth day. Her bowels appeared normal in every respect. After being home for two days, as a result of her moving around too freely, she developed a phlebitis of the right femoral vein. Under rest, elevation, and the use of an ichthyol dressing (50 per cent.) the condition cleared up in ten days.

Granting that the ileum is about 12 feet, the patient should have about 1 foot 6 inches left of this portion of the small bowel. The writer realizes that even yet nutritional disturbances may follow, but up to the present time her physical condition is entirely satisfactory.

This case is reported with the desire that other seemingly hopeless cases of intestinal injury (or new growth) may have the benefit of extensive resection.

## RIGHT INGUINAL HERNIA FOLLOWING APPENDECTOMY.

BY JOSEPH PIERRE HOGUET, M.D.,

OF NEW YORK.

Instructor in Surgery in the Cornell University Medical School.

FOR some time past the importance of preserving the nerves of the abdominal wall in doing laparotomies has been more or less realized, but it is doubtful if many know what the result of the destruction of one or more of these nerves means. This general subject has been gone over before in a previous paper published by the author in the *ANNALS OF SURGERY* for August, 1911. It was while working on that subject that the frequency of right inguinal hernia, after the apparent injury to one of the abdominal nerves in doing an appendectomy, became apparent. In order to establish more exactly the frequency of this condition, the records of St. Luke's Hospital, of New York City, were gone through and the history and physical examination of the last 190 cases of right inguinal hernia were looked through, in order to find out whether the patient had had an antecedent appendectomy. All congenital and double acquired hernias were naturally omitted.

For the privilege of using these records and reporting these cases, the author is indebted to Drs. C. L. Gibson and Robert Abbe, on whose services these patients were admitted to the hospital.

Altogether eight cases of right inguinal hernia were found in which there had been a history of an antecedent appendectomy, the time of appearance of the hernia varying, the shortest one being two weeks after leaving the hospital and the longest, four years. The greater proportion occurred in those cases in which the appendix wound had been drained, and in which, of necessity, it was larger, with a greater chance of

nerve injury, whether by directly cutting the nerve in doing the laparotomy or by the pressure on the latter by a drainage tube.

One case of special interest may be mentioned here, that of a young man, who was operated upon for acute appendicitis, the wound being drained. He stayed in the hospital six weeks, and was readmitted six years afterward with the history that his wound had given him no trouble until two weeks before admission, when it became swollen and tender. The old wound was then incised on two separate occasions, and considerable pus found between the layers of the abdominal wall. This healed up in about four weeks, and he left the hospital only to be readmitted in 15 days with a right inguinal hernia which he said he had noticed for the first time two or three days after his last leaving the hospital.

The reason for the appearance of these hernias is quite obvious. Practically all of the muscles in the region of the inguinal canal receive their nerve supply from the first lumbar nerve through its iliohypogastric and ilio-inguinal branches, the former supplying considerably more muscle, especially the lower part of the internal oblique and transversalis, commonly known as the conjoined tendon. The ilio-inguinal nerve is practically out of reach of the surgeon, emerging as it does just below Poupart's ligament about one and a half inches internal to and below the anterior superior spine of the ilium. The iliohypogastric branch, however, is generally more than one inch above the preceding, and runs downward and inward between the internal oblique and transversalis muscles. It crosses a line drawn from the umbilicus to the anterior superior spine almost two inches above the latter. Although the ordinary McBurney incision would run roughly parallel to the nerve, it can easily be seen in what danger the latter is, even though the fibres of the internal oblique are separated and not cut. The twelfth dorsal nerve takes the same course more than one inch higher up and is generally double.

Of course many cases are seen in which there is not only



a right inguinal hernia but also a hernia in the appendix scar. An example is given in one of the cases cited below. This naturally ensues from the cutting of the nerve, so that the muscle on the inner part of the wound being paralyzed is so flaccid that it not only admits the passage of a ventral hernia, but also causes a certain amount of retraction of the internal oblique and transversalis from Poupart's ligament, so that an inguinal hernia ensues.

The more essential points in the histories of the eight cases found in the hospital records are given below.

CASE I.—Appendectomy through McBurney incision for acute appendicitis with spreading peritonitis. Wound drained, patient left hospital in five weeks. Readmitted ten months from date of first operation with a hernia in the appendix scar, and a right inguinal hernia, the latter having first been noticed one month before. Left inguinal region normal.

CASE II.—Appendectomy through McBurney incision for acute appendicitis with general peritonitis, counterincision in loin. Both wounds drained. Patient left hospital cured in six weeks. Readmitted three years and two months from date of first operation with a right inguinal hernia, which had appeared thirteen months previously. Left inguinal region normal.

CASE III.—Appendectomy through McBurney incision for chronic appendicitis. Wound healed *per primam*, patient left the hospital in ten days. Readmitted in one month with a right inguinal hernia which had first appeared two weeks before. Left side normal.

CASE IV.—Appendectomy through McBurney incision for acute appendicitis. Wound drained, patient left hospital in four weeks. Readmitted in one month with a right inguinal hernia first noticed two weeks before. Left side normal.

CASE V.—Appendectomy through McBurney incision for chronic appendicitis, in hospital ten days. Readmitted four years from date of first operation with a right inguinal hernia which had existed one year. Left side normal.

CASE VI.—Appendectomy for acute appendicitis. Wound drained, patient left hospital in six weeks. Readmitted in four years, with a right inguinal hernia that had existed six months. Left side normal.

CASE VII.—Appendectomy for chronic appendicitis, McBurney incision. Left hospital in ten days. Readmitted in eighteen months with a right inguinal hernia that had existed two months. Left side normal.

CASE VIII.—The case of abscess in old appendix scar mentioned above.

Several other cases of this kind have lately been observed. One was a right direct hernia which had appeared one month after an appendectomy. This man had never had any trouble in the inguinal region before, and when seen the left side was normal. Another case was that of a young man who had had an appendectomy through a Kammerer incision, and noticed a swelling in the right groin three months after the operation.

Of course, eight cases out of 190 is not a large percentage, but the claim can justly be made that these are very conservative figures. It is very possible that there have been others out of the 190 who had trouble and who did not come back to St. Luke's Hospital to be operated upon for the hernia, or the fact of the antecedent appendectomy might have been overlooked by the historian. Yet, to the author's mind, this is a condition that really exists and, although recognized, enough attention has not been paid to it.

## FRACTURE-DISLOCATION OF THE ATLAS.

BY F. L. CARSON, M.D.,

OF SHAWNEE, OKLA.

REPORTS of cases recovering after fracture-dislocations of the atlas are not infrequent, and my excuse in reporting this case is because recovery followed what was apparently a secondary myelitis, from which recovery seemed impossible, with the patient in such a desperate condition that operation seemed out of the question, and palliative measures alone were used.

CASE I.—W. T., aged twenty-nine, while riding on a roller coaster, standing erect, was thrown forcibly while at about the height of twelve feet, striking on his forehead, producing extreme extension. He was immediately stunned but not unconscious, was picked up, and with a little assistance went home. He complained of severe pain and stiffness of the neck, associated with swelling in the region below the right mastoid.

The patient was seen by various physicians before a correct diagnosis was made, after which a plaster jacket was applied, with relief from the pain and stiffness, from which he had suffered since the accident.

About two months after the accident the patient resumed his occupation as a street car motorman. He continued in this capacity without much inconvenience, until one cold, stormy night his car struck a drift, giving him a severe jolt and causing a return of the pain. His physician again applied the plaster jacket but this time without relief, and finally he was brought home, at which time I saw him in consultation, about four months after the injury.

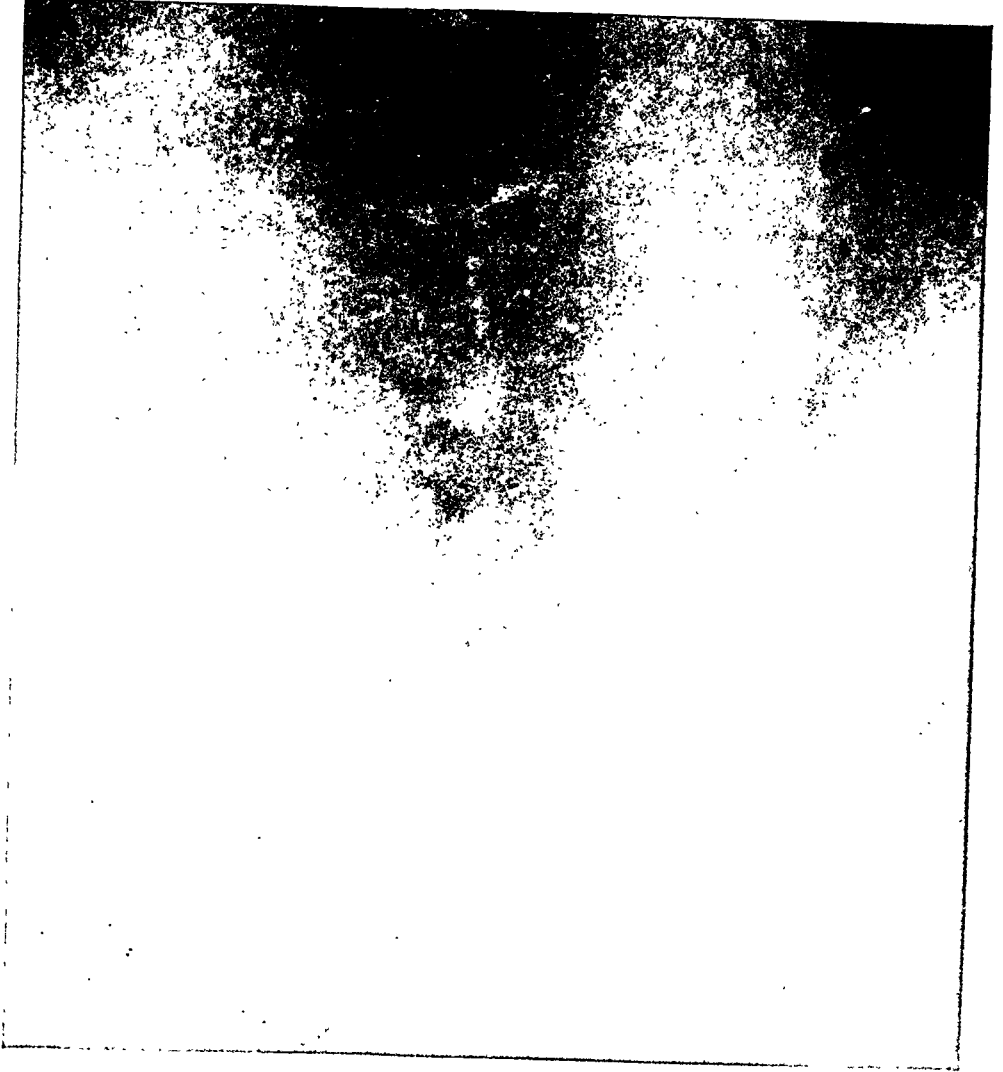
*Examination.*—Well nourished male. His head turned to the left. Involuntary contractures of all four limbs. Breathing entirely diaphragmatic. Complete analgesia below the clavicle. Incontinence of fæces and retention of urine. Hands and feet flexed. Marked prominence of posterior part of neck just below the mastoid. Bulging in the pharynx.

Patient was placed on his back and a collar around the chin and occiput applied, from which an 8-pound weight, over a pulley, was suspended. The head of the bed was raised about four inches, to overcome the traction. The pain at once became less severe, the paralysis after several weeks began to recede, first improving in the feet, then the legs, then the body, later the arms, and last of all the forearms. After allowing the patient to get out of bed an ambulatory extension apparatus was applied and worn for several months.

At the present time after nearly two years since the injury, the hands present evidence of paralysis. The fingers are clumsy, the interossei are atrophied, and the strength of the hands is very much impaired. The neck is much less rigid, there is no pain on attempts at motion. Swallowing food, at first difficult, is now easy. The patient at the present time is doing some manual labor, and is in fine general health.

The accompanying skiagram, while rather poor, shows the displacement to be marked. The recovery in this case, after a secondary myelitis, is unusual, and I believed worth reporting.

FIG. 1.



Fracture-dislocation of the atlas.



# MUSCLE GRAFTING FOR GUNSHOT WOUND OF THE SHOULDER.

BY BENJAMIN BRABSON CATES, M.D.,

OF KNOXVILLE, TENN.

IF the end results of traumatic surgery are not always brilliant, the surgeon may console himself with the thought that, even if the cosmetic effect may not be all that is desired, the functional utility of the limb is restored oftentimes to a surprising degree even in apparently hopeless cases, so that in the face of discouraging prospects it is often well worth while to adopt an expectant plan of treatment. Because in so doing, as time goes on, some plan may suggest itself whereby other tissues may be substituted for the destroyed parts, and the surgeon not only may have the satisfaction of seeing his patient go out with a useful limb, but he may also feel repaid for the time and labor devoted to the individual whose limb he saved. Besides he is spared that compunction of conscience and the element of doubt as to the course pursued had he sacrificed an essential part of the body before trying conservative methods.

Such a case illustrating the point under consideration was brought to me by Dr. J. D. Norton of Wildwood Springs, Tenn., and which I hereby report as follows:

December 27, 1910, Leonard D., farmer, aged twenty-one, a fine specimen of physical manhood, was out hunting with an old fashioned breech loading hammer gun. Attempting to cross a picket wired fence, he thrust the barrel of the gun, muzzle first between the pickets, the butt of the gun resting on the near side of the fence. He then climbed over the fence, and as he did so, being a heavy man, he bent the fence forward. As he attempted to pick up the gun by the muzzle, the stock still being in the fence, the fence flew back and in so doing caught one of the hammers in the wire. As a result the gun was discharged; the load tore away the front of the man's axilla, the insertion of the pectoralis major, and the upper third of the biceps muscle;

it also made an oblique fracture of the surgical neck of the humerus.

The patient lived twenty miles in the country, consequently I did not see him until the next morning, as it was impossible to get him to the hospital earlier.

Examination showed a fearfully lacerated and contused wound, laying open the entire axillary space, exposing the brachial plexus of nerves, the main axillary vessels, and the deltoid muscle which were intact.

I nailed the fractured ends of the bone together (the nail subsequently loosened up and was removed) and packed the wound with corrosive sublimate gauze. The wound was kept open and packed with corrosive sublimate compresses in order to allow the devitalized tissue to slough and in order to watch developments, such as secondary hemorrhage, etc.

January 3, 1911, he had a slight hemorrhage from the anterior circumflex artery, which was controlled by compression. January 10, 1911, he nearly bled to death from sloughing of a branch artery near the brachial, as the blood ran down under him and was not noticed by the attendant. This was also controlled by packing. For twenty-four hours he hovered between life and death but finally rallied satisfactorily.

After all necrotic tissue had been thrown off and the supuration had nearly ceased and the wound had commenced to cicatrize, the problem became important to devise some way to give him a useful arm and to cover over the axillary space.

I did not wait for complete cicatrization before operating on account of the danger of scar tissue causing ischæmic paralysis and the probability of great difficulty in identifying the different structures.

In order to understand the steps taken to restore the function of the arm and shoulder, it will be necessary to remember the condition of things confronting us.

Here was a patient with the axillary space laid open, the axillary vessels and nerves exposed, the biceps nearly to the middle of the arm gone (making flexion of the forearm impossible), the head of the humerus ankylosed, and a fracture of its surgical neck.

It occurred to me that by resecting the head of the humerus with an inch or more of the shaft we could shorten the arm



FIG. 1.



Showing result of plastic to cover in defect of wall of axilla caused by a gunshot wound. I, ribbon of skin taken from arm; II, flap from chest. Note the degree of flexion of the forearm.



enough to use, without tension, the coracobrachialis and anterior half of the deltoid muscles as fixed points of attachment for the biceps muscle if it were sutured to its upper end.

Having offered this plan of operation to the patient, he readily accepted the suggestion. So, February 8, 1911, I removed the ankylosed and carious head of the humerus and resected an inch or more of the shaft; then loosened the insertion of the coracobrachialis and the anterior half of the deltoid and sutured them with several strands of catgut to the freshened upper end of the biceps muscle. In order to lessen tension on the sutures the arm was kept in hyperflexion.

These different steps of the operation being completed, there still remained to cover over the axillary space. To do this a flap of skin was dissected from the front of the chest and slid over the axillary space and united with a narrow ribbon of skin crowded from the arm. The flaps readily united at their apposing edges and the raw surfaces exposed by their removal were allowed to granulate and cicatrize.

That the methods pursued to give this man a useful limb, and that the period of operation was well timed have been justified by the subsequent course of events.

The patient's arm is filling out and he says for carrying purposes is as strong as his sound arm. Of course the latitude of motion is not as great as before the injury and probably will never be; while he cannot carry his hand to the top of his head, he can, however, feed himself, wipe his face, and carry his fingers to the opposite shoulder with the injured limb.

The nerve supply of the arm and forearm is intact, and the radial artery at the wrist is unimpaired. In fact the upper limb from the elbow down is normal.

It is well in this connection to mention that at times he has associated movements—when he attempts certain motions, as in raising the shoulder, when flexing the forearm, and *vice versa*. In fact, Dr. Wm. R. Cochrane, who examined him at my request, could cause contraction of the fused deltoid and biceps by placing one pole of a galvanic current over the grafted deltoid and the other pole over the brachial plexus at the root of the neck.

The accompanying photograph (Fig. 1) taken July 8, 1911, shows the condition of the patient nearly seven months after the injury.

# ON IMPACTED FRACTURES THROUGH AND NEAR THE FEMORAL NECK.

BY V. ZACHARY COPE, M.D., M.S. (Lond.), F.R.C.S. (Eng.),

OF LONDON,

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THE main object of this paper is to call attention to the comparative frequency of impacted fracture near and through the neck of the femur, and to point to some features which may cause difficulty in diagnosis. The subject of injuries around the hip is time-worn, but many facts demonstrated by the Röntgen rays have not yet obtained due prominence in the current text-books on general surgery. Till comparatively recent years, the question of fracture near the hip resolved itself into distinguishing between "intracapsular" and "extracapsular" fractures of the femoral neck. Hard and fast distinctions were laid down whereby the one or other could be diagnosed, and outside the conventional types of injury diagnosis was doubtful. Intracapsular fracture of the neck of the femur was said seldom to be due to direct violence and rarely to be impacted. This teaching must have been responsible for many mistakes in diagnosis.

We are concerned here only with those injuries in which impaction occurs. These are almost always due to direct violence. In the event of direct violence being applied over the great trochanter, as in the common accident of a fall upon the hip, the force is transmitted along the femoral neck. This oblique force can be resolved into a horizontal crushing component which leads to impaction, and a vertical component which is most likely responsible for the upward displacement of the trochanter and shaft. According to the exact direction of the applied force, these horizontal and vertical components vary, and there result different kinds of fractures and displacements. In the case of indirect

violence, it is rare to get impaction primarily, though this may result from the fall upon the trochanter which frequently follows.

It is a law of mechanics that when a force acts transversely to a straight rigid rod fixed at one point, the breaking strain at any particular place is greater the nearer to that fixed point. In the case of a jar transmitted upward through the femur, the line of force passes vertically up through the top of the shaft and acts more or less transversely to the neck. The centre of rotation in the head may be taken as the fixed point, and the breaking strain along the neck will increase as the head is approached. This accounts for the fact that indirect violence usually causes a fracture of the neck just below the head (*subcapitalis*) and also for the occasional separation of the epiphysis of the head from a similar injury. It will be noted, however, that such indirect force only tends to produce vertical displacement, and there is no horizontal force which would lead to impaction.

The form of direct injury which causes an impacted fracture is usually a fall, whereby the hip strikes the ground, more rarely some heavy object falling on the hip may be responsible. The precise lesion resulting depends upon the age of the patient and the direction of the injuring force. Up to the age of twenty, at which time the epiphysis of the head should be joined to the neck, it is not unusual for the epiphyseal attachment to give way and a traumatic coxa vara to result, though fracture of the neck at this age is by no means unknown. During middle age and later years an impacted fracture of the neck or trochanter region results.

The position of the fractures cannot be foretold by considering the amount or kind of violence. Similar injuries may lead to fractures at different places.

For descriptive purposes we may divide impacted fractures in this region into: (1) impacted fractures through the neck of the femur wholly within the capsule; (2) impacted fractures through the base of the femoral neck or in the trochanter region. It must be understood that by an im-

pacted fracture we mean one in which the fragments are not movable on one another immediately after the accident. Many such a fracture becomes unimpacted owing to ill-directed manipulation. As soon as it is evident that serious injury has occurred, no rough handling should be undertaken before the X-rays have indicated the presence or otherwise of impacted fracture.

(1) Impacted fracture of the femoral neck within the capsule is not of such infrequent occurrence as the textbooks would have us believe. A treatise on fractures published only last year states with regard to fracture of the neck of the femur: "rarely this form of fracture may arise from blows upon the trochanter." This statement perpetuates the traditional view held before the introduction of X-rays. It can be definitely asserted that it is comparatively common to find an impacted fracture of the femoral neck wholly within the capsule, resulting from violence directly applied over the great trochanter.

There are two groups of cases. The first conform more or less to the type description of "extracapsular" fractures, *i.e.*, shortening, eversion, and loss of power in the limb, but unless considerable violence is used crepitus will not be elicited. Bruising over the hip may or may not be a noticeable feature.

The second variety is atypical, and gives rise to varying deformity according to the direction of impaction. Slight shortening and various degrees of flexion, adduction, and inversion result. There are three reasons why an error of diagnosis may occur in this fracture. In the first place the shortening is but slight, half an inch or under being quite usual. Those who have done much measuring of lower limbs will appreciate the statement that differences of half an inch or under are not always easy to determine; for it may be difficult to locate the anterior superior spine accurately in a fat subject, and sometimes spasm of the muscles will prevent the limbs being adjusted symmetrically to the pelvis. Secondly, the impaction may produce an attitude of the limb not usually associated with fracture; for instance, in the

SKIAGRAM I.



Impacted fracture of neck of femur near the head, due to direct violence. (Case I.)

SKIAGRAM II.

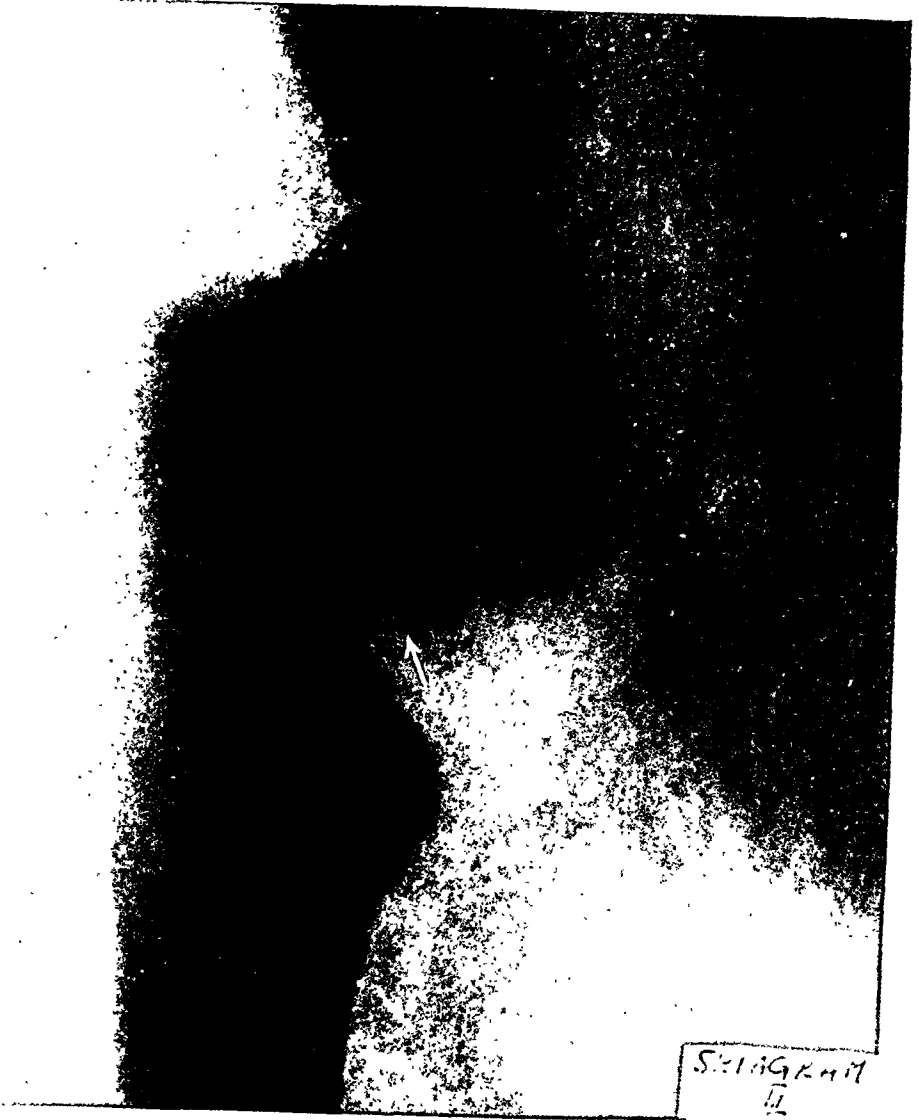


SKIAGRAM  
II

Impacted fracture of neck of femur associated with adduction and flexion of thigh. (Case II.)

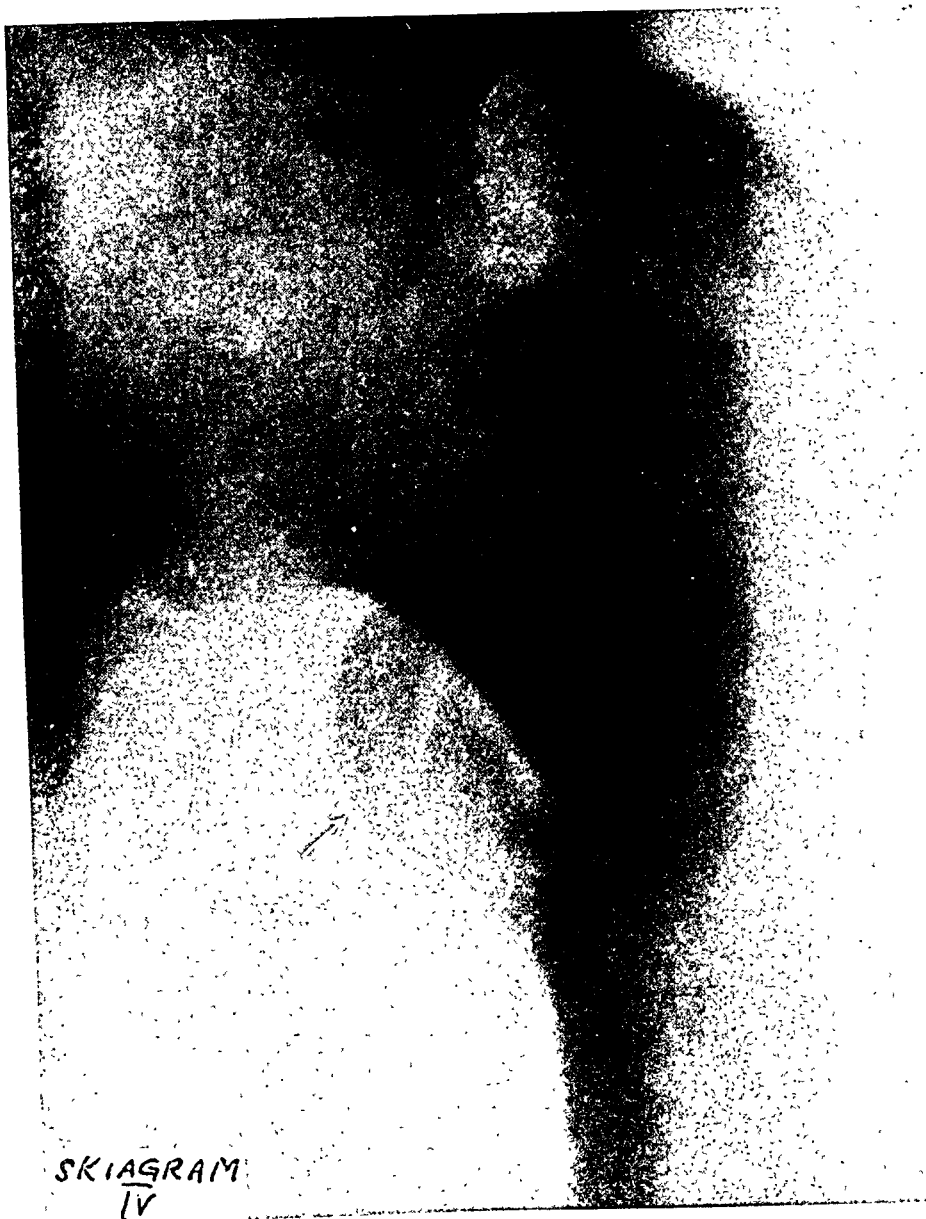


SKIAGRAM III.



Impacted fracture through base of the neck of the femur (Case III). Skiagram taken five days after the accident.

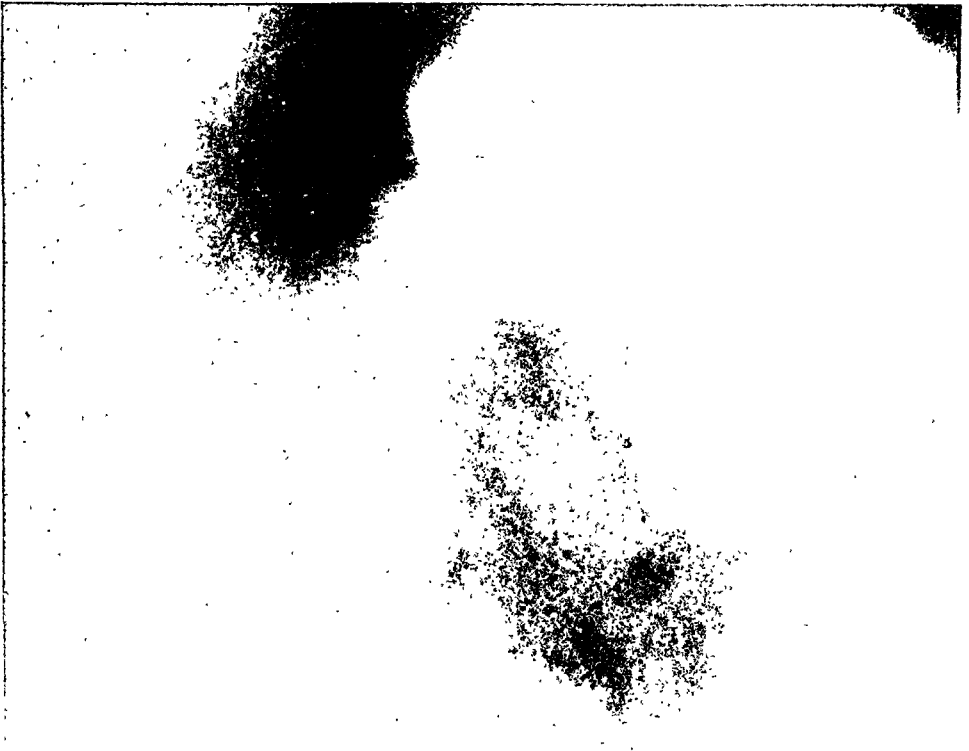
SKIAGRAM IV



SKIAGRAM  
IV

Fracture through the base of neck with impaction but no shortening. Arrows point to lines of secondary fracture. See Fig. 1 and Case V.

SKIAGRAM V.



SKIAGRAM  
V

Impacted fracture of base of neck. The common type of injury. The detached top of great trochanter can be seen displaced inward. See Fig. 2.

SKIAGRAM VI.



Impacted fracture through base of neck of femur. Third type of injury. See Case VII and Fig. 3.

second case quoted below, the position assumed by the limb resembled that due to a dorsal dislocation of the hip. Thirdly, the loss of function at the hip may not be complete. It may be possible for the patient to lift the limb off the bed or even to bear the weight on it and walk about, though limping.

As illustrations of the two groups of cases the following will serve:

CASE I.—W. P., aged sixty-five, was knocked down and fell on the right hip. On admission (September, 1910) there was eversion and slight abduction of the right lower limb, which was half an inch shorter than the opposite member. Pressure over the great trochanter was painful, but no bruising was visible. The iliotibial band was slacker than on the sound side. Voluntary movement at the hip-joint was just possible, but painful. Skiagraphy showed an impacted fracture of the femoral neck near the head, and wholly within the capsule (see Skiagram I).

This illustrates the first type. The second group is exemplified in the next case.

CASE II.—W. S., aged thirty-eight. Fell off a bicycle on the right hip three weeks before admission. For a short time he rested, but soon got about again, though he limped painfully. His injury was not treated as a fracture, and no improvement took place. On admission (August, 1910) he was still able to walk, though with difficulty. The right lower limb was three-eighths of an inch shorter than the left, and was kept in a position of flexion and slight adduction. Abduction was impossible. Rotation outward and inward was limited and painful. There was pain on pressure over the great trochanter, which was no nearer the middle line than that of the opposite side. A skiagram showed a fracture of the neck within the capsule and just below the head. The neck was impacted tightly into the upper part of the cancellous tissue of the head in such a way as to account for the adduction and flexion of the limb (see Skiagram II).

In both the above cases movement at the hip-joint was possible though attended by pain. In the second patient the position of the limb simulated dorsal dislocation, but by considering the nature of the injury, the small amount of shortening, and the rather atypical deformity, a diagnosis was possible apart from the X-ray finding.

Owing to the kindness of Dr. Harrison Orton I am able to include a skiagram of another case.

CASE III.—Patient fell off a bicycle on to the hip. He worked for two days afterwards, getting about his ordinary vocation though with some pain. Then he was compelled to take to bed. The skiagram was obtained five days after the accident. It shows a tightly impacted fracture through the neck (see Skiagram III).

It is quite possible that some cases of fracture through the neck caused by indirect violence (*i.e.*, the common fracture in very old people) may become tightly impacted because of an immediate subsequent fall upon the trochanter of the affected side. In most of the cases I have seen, though chiefly affecting elderly people, this causation was negatived by the nature of the accident. The following case, which I am able to give owing to the courtesy of Mr. Warren Low, illustrates this possibility. I can do no better than give the account in Mr. Low's own words.

CASE IV.—“The patient was an active old gentleman aged seventy-three, who, two years before I saw him, whilst travelling in Italy, tripped and fell upon his trochanter. He continued his sightseeing for the day, but stayed in bed for the next five days. He was afterwards able to get about, visiting Florence and Rome. He had been seen by an Italian doctor who assured him that nothing was broken. This assurance was repeated in Paris where he again sought advice, and again when he reached London. I may mention that he stated that, some time after the accident, while travelling to Paris in a jolting train he felt a sudden sharp pain in the hip region, and ever after that the hip gave him more trouble. I saw him two years after the accident, and

whatever may have been obscure before, was then quite obvious. The movements round the left hip-joint were quite free with the exception of internal rotation and abduction, but active movements though free were feeble. The limb was one and a half inches shorter than its fellow, and the trochanter was above Nélaton's line. Moreover, on rotating the femur, the trochanter rotated on its own axis and not through the arc of a circle of which the neck of the bone was the radius. It was not a difficult matter to diagnose a fracture of the neck of the bone with a false joint, and this was confirmed by skiagraphy."

This case must have been a tightly impacted fracture at the first, else it could not have been altogether missed by the doctors who saw him at or soon after the occurrence of the accident.

(2) Impacted fracture through the base of the femoral neck and the trochanter region includes all those which used to be loosely called "extracapsular fracture of the neck," a terminology anatomically incorrect and clinically of doubtful value.

From outward appearance it is often difficult or impossible to tell whether this fracture or an impacted fracture near the head has occurred. Both occur in middle or old age, and result from the same kind of violence. Perhaps slightly greater force is responsible for fracture through the base of the neck, for shortening and eversion of the limb and bruising over the trochanter are more marked in these cases. Owing to this greater bruising and more severe injury, movement at the hip is more uncommon. But the mechanism of the two fractures is quite different. In fracture through the neck the firm tissue of the lower part of the neck is driven and tightly impacted into the cancellous tissue of the upper part of the head; in fracture through the base of the neck the cancellous tissue of the great trochanter is split up by a firm wedge of bony tissue belonging to the cervix femoris. This wedging of the cervix into the trochanter region is responsible for two or three secondary fractures which frequently complicate the primary breakage (see Fig. 1).

One is due to vertical splitting of the great trochanter, and usually separates off the posterior part of the great trochanter and the adjoining bone, including the lesser trochanter and even a little of the shaft beyond; another is horizontal, and detaches the top of the great trochanter from the previous fragment. Occasionally, and probably from a greater degree of violence, the lesser trochanter and a flake of adjacent bone from the shaft are split off, owing to the cutting action of the lower compact tissue of the neck.

It has been pointed out by Ralph Thompson that the *calcar femorale* probably plays an important part in the causation of these secondary fractures. The *calcar* is a vertical plate of more compact bone standing upright in the midst of the cancellous tissues of the femoral neck. Its base is attached to the inner and under surface of the neck as far down as the lesser trochanter, and its outer edge points like a vertical razor edge towards the great trochanter. When a force is applied over the hip, this firm blade tends to split the great trochanter in a more or less vertical direction. From a study of skiagrams it would appear likely that the upper layer of compact tissue of the neck acts as a blade to produce the secondary horizontal fracture. It seems likely that the lower layer of compact tissue of the neck is responsible for the occasional splitting away of the lesser trochanter and adjacent portion of the shaft.

Three grades of injury have come under my notice. In the first a primary fracture occurs at the junction of the head and neck, and the base of the neck is then thrust into the cancellous tissue of the great trochanter. The lines of the secondary fractures (horizontal and obliquely vertical) can be seen, though no separation of the fragments takes place (see Fig. 1 and Skiagram IV).

The second grade shows a more advanced condition. The firm tissue of the neck causes separation of the fragments of the trochanter along the lines previously mentioned. The base of the neck loses its support, and marked shortening occurs. The tip of the great trochanter is nearly always



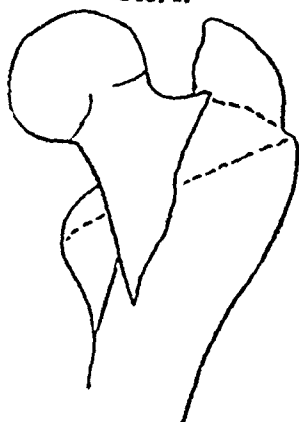
drawn inwards toward the upper rim of the acetabulum. This is probably due to the action of the numerous muscles attached to its upper border. This grade of injury is the most common type of fracture resulting from a fall on the hip (see Fig. 2 and Skiagram V).

A third type of injury is shown in Fig. 3 and Skiagram VI. In it the process is carried one stage further, for the small trochanter and a slice of shaft are also split off.

The following are illustrative of the three types:

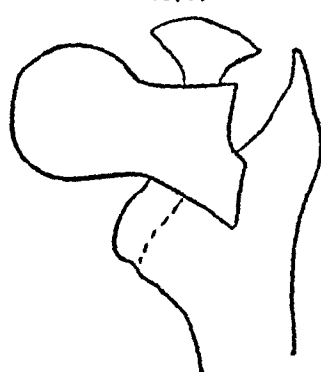
CASE V.—J. B., aged forty-two (admitted February, 1911). Gave history of stumbling and falling heavily upon the left hip

FIG. 1.



Showing lines of primary and secondary fracture in Case V.

FIG. 2.



Showing lines of separation in common type of fracture through base of neck.

as he was trying to get into a train. When admitted, there was eversion and slight adduction of the left lower limb. No shortening was obtained, but there was definite relaxation of the iliotibial band. Some indefinite crepitus was felt on moving the femur, but this was elicited only once or twice. The patient could move his limb at the hip, though with some pain. The skiagram showed a fracture through the base of the neck which ended below in the lesser trochanter. The dense neck had been firmly impacted into the cancellous tissue of the upper portion of the shaft, and had begun to split off the upper part of the great trochanter. No shortening was obtained, since there was no alteration of the angle of the neck with the shaft, and no displacement in a vertical direction. The only positive

sign was relaxation of the iliotibial band (see Fig. 1 and Skiagram IV).

The effects of still greater violence, or of similar violence acting on an atrophic bone, are shown by the following:

CASE VI.—E. S., aged seventy-nine. Was accidentally knocked down by a blind man and fell upon her left hip. On admission, pain made examination difficult. The left lower limb was everted, and there were two inches of shortening. Voluntary movement was just possible, but very painful. The X-ray negative revealed an impacted comminuted fracture through the trochanters. The neck had evidently been wedged in between the two trochanters and separated portions of both. The appearance was exactly as if a further amount of violence had been applied to the previous case. The angle between the neck and shaft had been diminished almost to a right angle. See Skiagram V and Fig. 2.

This case shows why shortening varies so greatly in fracture through the base of the neck. When the force is only of moderate severity, the neck is firmly fixed by its impaction into the neighboring cancellous tissue; but when the impact is severe enough to break up the trochanter, resistance to vertical displacement disappears, and the vertical component of the injuring force leads to considerable displacement and shortening.

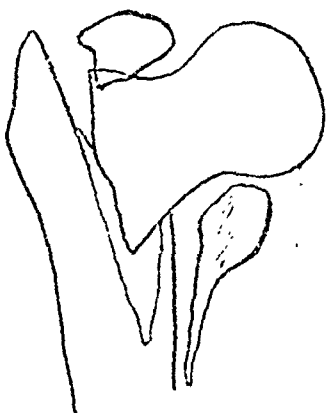
In view of the fact that the top of the trochanter is drawn inward, it might be advisable to put some of these fractures up in an abducted position. Skiagram V and Fig. 2 show a similar condition, though not taken from this actual case.

A still further degree of violence occurred in a case more recently in St. Mary's Hospital.

CASE VII.—Patient fell a distance of 25 feet upon the right hip. On admission there was much bruising over the right hip, and one and a half inches of shortening. The iliotibial band of fascia was relaxed on the affected side. Crepitus was elicited.

The limb lay in an everted position and no voluntary movement was possible. There was a swelling in the upper part of the thigh. A skiagram showed a fracture through the base of the

FIG. 3.



Showing the third type of fracture through base of neck (Case VII).

neck with separation of the lesser trochanter and a slice of the adjacent shaft (see Fig. 3 and Skiagram VI). The lower end of the cervical wedge caused this detachment.

#### CONCLUSIONS.

1. Impacted fracture of the neck of the femur (within the capsule) is by no means an uncommon occurrence.
2. It results from direct violence applied over the trochanter major, and may permit of considerable voluntary and passive movement of the hip without crepitus.
3. An unimpacted fracture resulting from indirect violence may occasionally be converted into an impacted fracture owing to an immediately subsequent fall upon the affected hip.
4. The impaction may cause an atypical deformity, even sometimes simulating dorsal dislocation.
5. Fracture of the base of the neck is always primarily impacted; if the force applied is great, there are always secondary fractures, both vertical and horizontal, through the trochanter region.

6. Persons with impacted fractures of the femoral neck or base of the neck may and often do walk about for some days after the accident.

7. An impacted fracture of the base of the femoral neck may exist without appreciable shortening when the force is not sufficient to cause the trochanter region to be split up by the wedge-like cervix femoris.

In conclusion I wish to express my indebtedness to Dr. Harrison Orton for his kindness in allowing me to make use of all the radiographs inserted.

# NOTE ON CATGUT STERILIZATION.

A PRELIMINARY REPORT.

BY WILLARD H. HUTCHINGS, M.D.,  
OF DETROIT.

SEVERAL years ago the writer began an experimental study of the various methods which have been employed for the sterilization of catgut. The longer I worked with them the more I became convinced that the secret of catgut sterilization lay in the complete removal of all traces of water. After trying a great many methods, most of which failed, the following was evolved which will sterilize catgut without impairing its physical qualities. The point of the method lies in the way the water is removed. This is done in a vacuum over sulphuric acid. It is a well-known physical fact that in a vacuum of less than 4 mm. of mercury water vaporizes. For example, a piece of ice placed in a desiccator under less than 4 mm. pressure will remain ice until it completely disappears without liquefying. The sulphuric acid absorbs the water vapor as fast as it is formed. It is also well known that in the absence of water very few, if any, chemical changes take place. Therefore a perfectly dry catgut can be heated nearly to the charring point without materially injuring it. It has also been proved by repeated experiments that 150° C. dry heat for two hours will kill all germs, with few exceptions, these being non-pathogenic. This is the, almost universal, method employed by bacteriological laboratories to sterilize infected glassware, etc.

Based on these principles, the method I employed is as follows: Raw catgut without any previous treatment is placed in suitable containers which are left open. In my work I have employed a simple straight glass tube sealed at one end, the other being open. These tubes are then placed in an ordinary vacuum desiccator, the bottom of which is covered with sul-

phuric acid and connected with a vacuum pump. The air is then exhausted until a pressure of less than 4 mm. is secured, the more perfect the vacuum the better the result. When this is attained the desiccator is closed, disconnected from the pump, and set aside. Eight days are long enough to secure dryness. At the end of this time air is allowed to enter the desiccator. If perfectly dry air is needed it can first be passed through Wolff bottles containing sulphuric acid. The tubes are then rapidly sealed and are ready to sterilize. Any method of heating may be employed. Hot air ovens have been found uncertain, as it is very difficult to regulate the temperature. In my work I have employed a mixture of glycerin and distilled water with a boiling point of  $150^{\circ}$  C., the container being fitted with a reflex condenser. The sealed tubes are placed in this and boiled two hours, thus securing two hours of dry heat at  $150^{\circ}$  C.

Any method of sterilizing catgut must fulfil certain requirements. First it must render the catgut sterile. It is not sufficient that it kill the various micrococci, colon bacillus, typhoid bacillus, and possibly anthrax. It must absolutely destroy every germ which may in any remote way produce infection. And it must do it every time. Sterility is the prime requisite. In addition, the physical characteristics of the catgut should not be impaired. It must be strong, elastic, absorbable. In order to test the sterilization of gut prepared in this way, the following experiments were undertaken: Number 4 catgut was cut in one and one-half inch lengths and placed in 250 c.c. Erlenmeyer flasks, containing suitable culture media. These flasks were then inoculated with "hay" bacillus, "potato" bacillus, anthrax, tetanus and dirt from the street (aërobic and anaërobic) and incubated at  $37.5^{\circ}$  C. for 21 days. At the end of this time they were removed and submitted to the sterilizing process above described. One hundred and fifty samples of each kind of infected gut were used. They were then planted in suitable culture media and incubated for 14 days. Not one of the samples gave a growth. There were also no contaminations. In order to be perfectly sure that the

were sterile, twenty-five samples of anthrax and tetanus gut were transplanted into guinea pigs. In no instance did they produce anthrax or tetanus in the animal. Control animals which were inoculated with the gut before sterilization died of the diseases.

The tensile strength of the gut was tested in the following manner: Samples of gut one foot in length were attached at one end to a self-registering scale, at the other to a windlass in such a manner that the strain could be applied steadily. Force was applied until the gut broke. In this manner one hundred samples of gut were tested before treatment and one hundred after sterilization. The raw gut gave an average breaking strain of 8.7 pounds, while the sterilized gut gave an average of 8.9 pounds. In other words, the sterilized gut was a little stronger than the raw gut. This is in accordance with the well-known fact that a dry piece of wood, for example, has a higher tensile strength than a green piece.

Tests for absorbability were made on guinea pigs and showed that No. 2 gut was absorbed in nine days. The appearance and elasticity of the gut is not altered by the process of sterilization. Instead of being roughened during sterilization it is even smoother than before. The following conclusions are justifiable:

1. That gut prepared by this method is sterile.
2. That its tensile strength is not impaired.
3. That it remains in the tissues long enough to fulfil the purpose for which it is intended.

Unfortunately the method is not simple. It requires rather complicated apparatus and a first-class vacuum pump. The above is in the nature of a preliminary report. It is intended to experiment further in an effort to not only simplify the method but to secure wider applications if possible.

# THE TREATMENT OF LACERATED AND INCISED WOUNDS OF THE EXTREMITIES.\*

WITH A REPORT OF FIVE TYPICAL CASES.

BY JAMES A. KELLY, M.D.,  
OF PHILADELPHIA.

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ALTHOUGH marked advances have been made in the technique and treatment of abdominal conditions, our attention is often attracted to the fact that the treatment of lacerated, incised, and punctured wounds of the extremities has not kept pace with the work done in the other branches of surgery, and while the percentage of cases that were treated by primary amputation for destruction of the arterial or nerve supply, or by secondary amputation for gangrene due to thrombosis of infection, is not so great, the fact remains that the ultimate result, as shown in the loss of function, muscular atrophy, contractures, and the often-marked involvement of sutured tendons, nerves, and blood-vessels in one mass of cicatricial tissue, is very poor. This condition greatly limits the usefulness of the individual, decreases his earning capacity, and too frequently ends in prolonged lawsuits for indemnity. It is with the object of bringing this common condition before the attention of the Fellows that I wish to present this report of five typical cases.

CASE I.—*Cartridge shell wound of the arm, involving the brachial artery, basilic vein, and median nerve; circular arteriorrhaphy, circular phleborrhaphy, and neurorrhaphy.*

Mrs. A. G., sixty-six, w. housewife, Germany, admitted to St. Mary's Hospital July 4, 1910. Patient, while walking along the street July 4, 1910, heard an explosion as a trolley car passed and at the same time felt something strike her in the upper arm,

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\* Read before the Philadelphia Academy of Surgery, May 1, 1911.



accompanied by a sharp stabbing pain in the same region which radiated down the forearm to the hand and fingers. The patient noticed a small amount of bleeding from the wound, and on account of this and the pain went to the hospital.

On admission the arm was thoroughly cleansed and an anti-septic dressing applied. The wound was not considered to be of great importance by the resident physician and he did not notify me until the next morning, when examination showed complete paralysis of the muscles supplied by the median nerve and apparently no injury to other important structures. The arm showed a small transverse wound 1 to 1.5 cm. long on the anterior surface of the right arm about the junction of the middle and upper thirds, through which there was a small amount of blood oozing. The entire inner aspect of the arm was swollen over an area of about three to four inches and was ecchymotic. Radial and ulnar pulses were distinctly palpable, but not as full as on the left side. An X-ray examination showed the presence of a small foreign body about 8 to 10 mm. square.

Under ether anæsthesia longitudinal incision  $5\frac{1}{2}$  inches in length was made, with its centre at the wound of entrance. On cutting through the deep fascia a large blood-clot was evacuated, and this was followed by a gush of arterial blood. A tourniquet above the wound and a careful dissection showed a transverse wound of the brachial artery involving half of its calibre, almost complete severance of the median nerve, and a transverse wound of the basilic vein involving its entire calibre. Further dissection revealed a small piece of a cartridge shell about 1 cm. square imbedded in the coracobrachialis muscle. The wound was thoroughly irrigated with hot normal salt solution, the edges of the wound of entrance excised, and the wounds in the brachial artery and basilic vein were closed by circular arteriorrhaphy and phleborrhaphy by Carrel's method. The cut ends of the median nerve were united by means of two fine silk sutures passed directly through the nerve. The operative wound was then closed with continuous catgut sutures uniting the deep fascia and interrupted silkworm gut through the skin. Drainage was provided for through a small stab wound about two inches above the internal condyle, using rubber dam. A dry sterile dressing and an internal angular splint were applied. The wound healed by primary union; the drain was removed in 48 hours, and the

sutures at the end of eight days. The patient was discharged at the end of three weeks and recommended to return for massage and passive motion.

Examination three months after operation showed normal pulsation of brachial and radial arteries, marked atrophy of flexor muscles, anæsthesia over areas supplied by median nerve; marked changes were present in the skin of the hand, particularly the fingers and thumb being thin, smooth, shiny, and cold; the nails were dry, dark in color, striated longitudinally, and there was marked sweating of the palm of the hand. There was marked stiffness of the elbow-joint in a position of semi-flexion, and also of the wrist and phalangeal joints. Voluntary flexion was absent in the fingers, was weak at the wrist-joint, and pronation of the hand was impossible. The patient complained of a general pain throughout the forearm and hand on attempts at movement.

Examination six months after operation showed a moderate return of sensation, muscular power, and a lessening of atrophic changes.

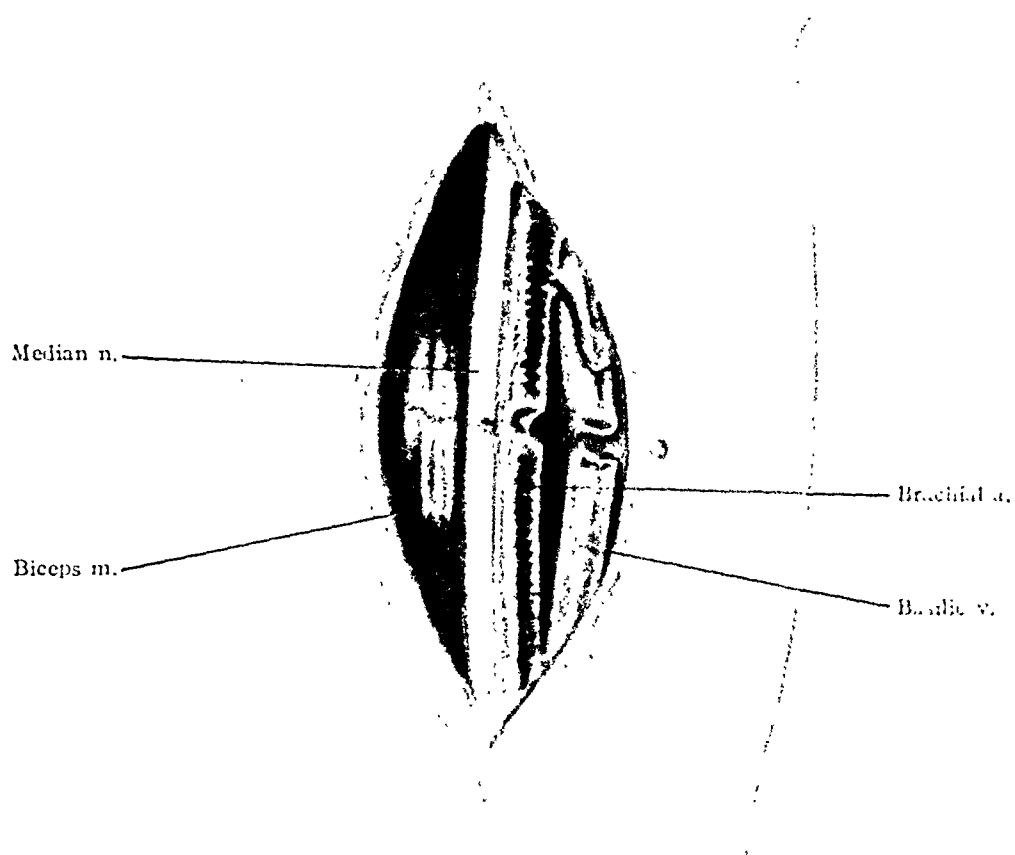
Examination March 30, 1911, showed a moderate degree of muscular atrophy, motions at elbow and wrist free, pronation and supination normal, flexion of fingers fair, still some trophic changes present over terminal phalanges, nails becoming smooth and normal in color at bases. No pain present on motion. General condition satisfactory.

CASE II.—*Lacerated wound of arm, severing biceps, portion of brachialis anticus, brachial artery, basilic vein, median and ulnar nerves; arteriorrhaphy, phleborrhaphy and neurorrhaphy.*

Jacob G., sixty-six years old, U. S., shuttle maker, admitted to St. Mary's Hospital September 23, 1910, at 2 P. M. Patient while at work had his clothing caught in a portion of the machinery and received a lacerated wound of the right arm from a circular saw. Admitted to the hospital in a profound state of shock.

*Examination on Admission.*—Patient in a profound state of shock. On the right arm there was a lacerated wound about six inches in length, extending from the junction of the middle and upper thirds on the external surface running downward and inward. Inspection of wound showed the biceps muscle, the brachialis anticus muscle, brachial artery, the basilic and cephalic veins, the median and ulnar nerves to be completely severed and

Fig. 1



Lesion present after exposure by incision. (Case I.)



FIG. 2.



Shows healed wound with scar of punctured wound at centre. Hand in position of full extension. Note the degree of atrophy still present. (Case II.)

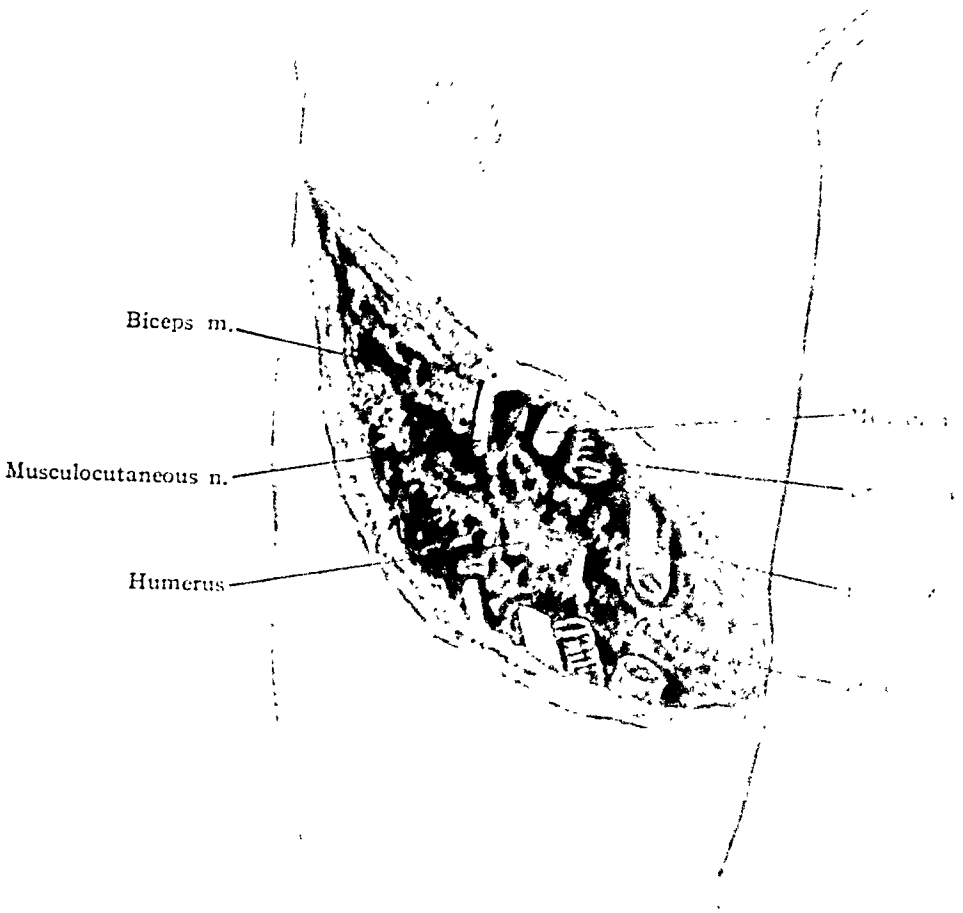
FIG. 3.



Shows the degree of flexion present, which is limited entirely by the stiffness of the phalangeal joints. (Case I.)



FIG. 4.



Showing the extent of the lateral incision.





the cut ends retracted, and the wound partially filled with blood-clot. The bleeding had been temporarily controlled by means of a cloth tourniquet. The patient was given an intravenous injection of one litre of normal salt solution, a shock enema and a temporary antiseptic dressing placed around the arm. At the end of three hours the patient had sufficiently reacted from shock to warrant operative intervention.

The patient was given morphine  $\frac{1}{4}$  gr., atropine  $\frac{1}{100}$ . The arm was thoroughly cleaned with soap and water and alcohol 70 per cent., and the wound irrigated with hot normal saline solution. Circular arteriorrhaphy of the brachial artery and circular phleborrhaphy of the basilic vein were performed, using the method of Carrel. It was then found necessary to give the patient a little ether to continue the operation. The cut ends of the median and ulnar nerves were sutured with fine silk by the direct method, and the cut portions of the biceps and brachialis anticus muscles were sutured with No. 1 interrupted chromic catgut, the fascia and skin being united with interrupted sutures of silkworm gut and drainage provided for at the lower angle of the wound with rubber dam. A sterile dressing and an internal angular splint were then applied. The patient was fully stimulated, and in spite of everything that could be done he failed to react and died about ten hours after leaving the operating room.

CASE III.—*Incised wound of the arm involving the brachialis anticus muscle; the tendon of the biceps, the basilic vein, the median and ulnar nerves, tenorrhaphy, myorrhaphy, neurorrhaphy.*

M. McD., sixteen years of age, schoolboy, admitted to the Polyclinic Hospital, September 8, 1910, service of Dr. Louis A. Steinbach, to whom I am indebted for the privilege of reporting this case.

Patient while painting the outside of the window frame was supporting his weight with his hand against the window pane, when the latter suddenly gave way and the patient partially fell through the window severely cutting his right arm with a piece of the broken glass. Admitted to the accident room of the hospital in a state of shock with a tourniquet around the upper part of the arm.

Examination on admission showed patient to be in a moderate degree of shock. The right arm presented an irregular lacer-

cised wound about four inches in length, beginning at the junction of the middle and lower thirds of the arm on the anterior surface running downward and inward. Retraction of the edges of the wound showed complete severance of the tendon of the biceps, a portion of the brachialis anticus muscle, the basilic vein, the median and ulnar nerves. Under ether anæsthesia the arm was cleaned with soap and water and alcohol 70 per cent., and the wound irrigated with hot normal saline solution. The separated portions of the brachialis anticus muscle and the tendon of the biceps muscles were sutured with No. 1 chromized catgut, the divided median and ulnar nerves were united with interrupted sutures of fine silk, the cephalic vein was ligated, and the fascia and skin closed with interrupted silkworm gut sutures. Drainage was provided for at the lower angle of the wound, and a dry sterile dressing applied. The wound showed a marked degree of infection several days after operation, which necessitated the removal of several of the sutures. The patient was discharged to the out-patient department for subsequent treatment September 24, 1910, sixteen days after admission. (Dr. Butler, Chief Resident.)

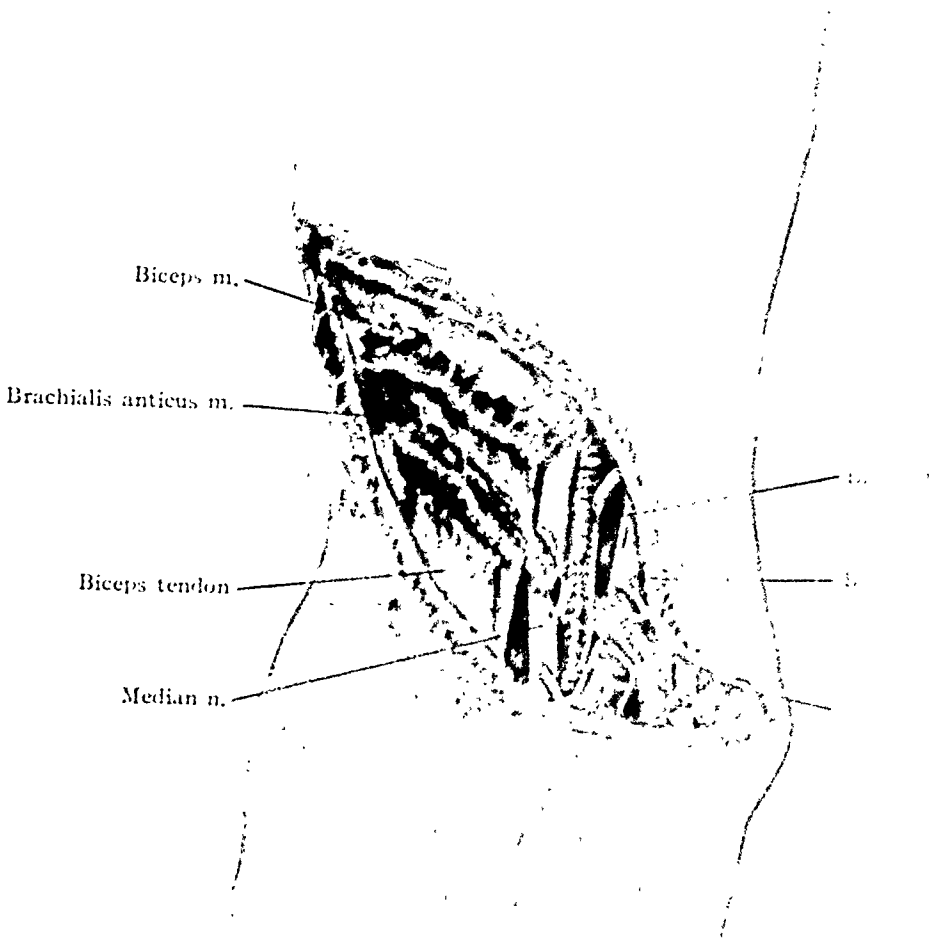
Examination March 30, 1911, showed normal flexion at the elbow, restricted motion of the wrist and of the fingers, most marked in the ring and middle fingers, still loss of sensation of index, middle, ring, and little fingers on flexor surfaces. Pronation and supination were still impaired.

CASE IV.—*Incised wound of forearm, flexor surface, involving the tendons of the flexor carpi ulnaris, palmaris longus, flexor sublimis digitorum, flexor profundus digitorum, excepting the division to the index and middle fingers, the ulnar artery, and the median ulnar nerves; multiple tenorrhaphy, neurorrhaphy.*

E. P., thirty-seven years of age, machinist. Accident occurred January 18, 1911. Patient, while at work at Cramp's shipyard, was struck on flexor surface of right wrist by a piece of a falling arclight globe.

Examination on admission showed a transverse incised wound about two inches in length on the flexor surface of the right forearm one inch about the hand. Through the separated edges of the wound were seen the cut ends of the ulnar and median nerves, the cut ends of the ulnar artery, the divided ends of the tendons of the flexor carpi ulnaris, the *palmaris longus*, the flexor

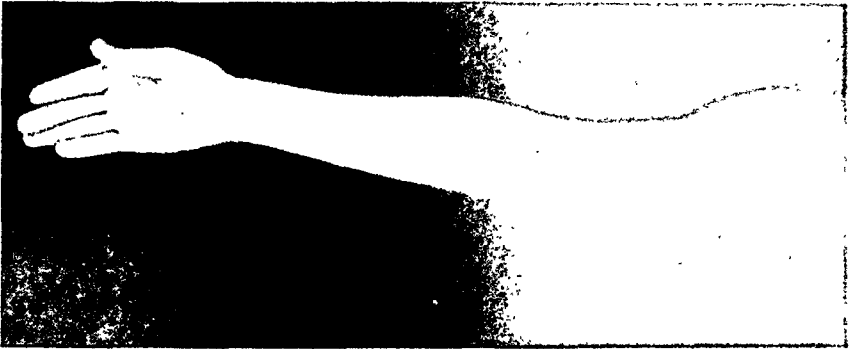
FIG. 5



Showing the extent of the lacerated wound and the position of the



FIG. 6.



Showing the healed wound, the muscular atrophy, and the degree of extension of the hand. (Case III.)

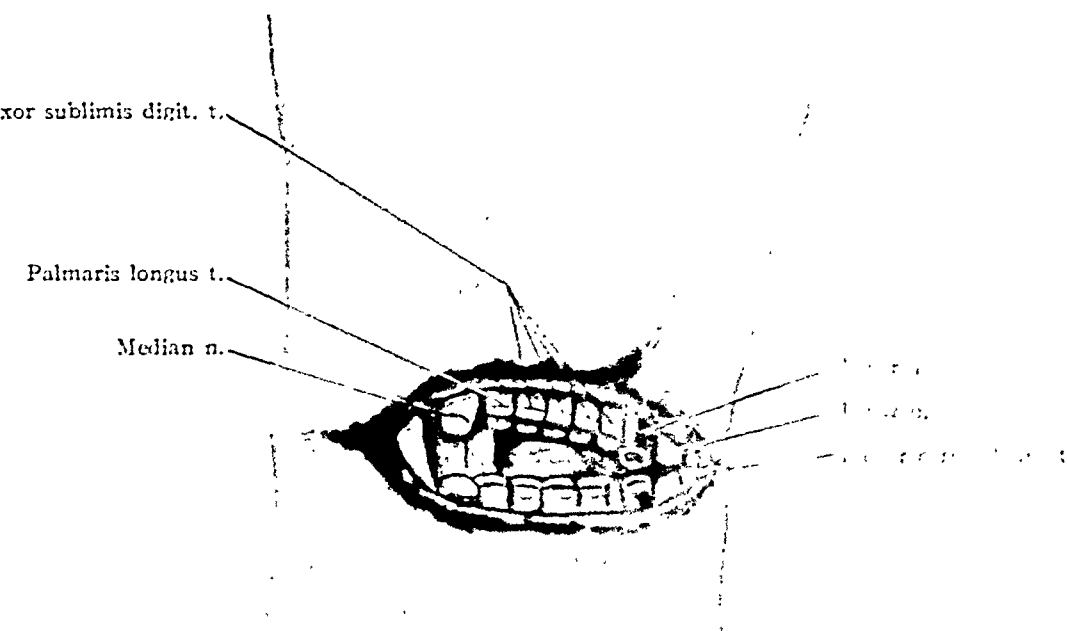
FIG. 7.



Showing the degree of flexion possible. (Case III.)



[Fig. 3.]



Showing the extent of the incised wound and the involved structures (Fig. IV).





FIG. 9.



Showing the healed wound and the amount of extension.

FIG. 10.



Showing the degree of flexion.



sublimis digitorum, and the flexor profundus digitorum, excepting the divisions to the index and middle fingers.

The operation was performed by the Resident Physician, Dr. McBride, without an anæsthetic, as the patient refused an anæsthetic. The arm was cleansed with soap and water and alcohol 70 per cent., and the wound irrigated with hot normal saline solution. The severed tendons were united individually with two interrupted sutures of silk, the cut ends of the nerves were united with interrupted silk sutures, the ulnar artery was ligated, the wound closed with interrupted silkworm gut sutures, a dry sterile dressing applied, and the hand dressed in extension on a splint. The wound healed by primary union, the sutures were removed on the eighth day and the splint at the end of two and a half weeks. Massage and passive motion were then instituted.

Examination March 30, 1911, showed the affected tendons to be firmly surrounded by scar tissue and united with the cicatrix of the skin; flexion of all the fingers was limited, particularly that of the ring and little fingers; cutaneous anæsthesia of hypothenar portion of the palm of the hand and the outer side of the ring and of the little fingers. There was marked tremor of the hand, which was cold and perspiring; the finger nails were moderately darkened, irregularly ridged, and longitudinally striated. The skin of the hand was thin, shiny, and bluish white. The scar was very tender and supersensitive. (In this case there is evidently separation of the cut ends of the ulnar nerve and a secondary nerve suture will be required.)

CASE V.—*Incised wound of the flexor surface of the forearm one inch above the wrist-joint, involving the tendons of the flexor carpi ulnaris, the palmaris longus, the flexor carpi radialis, the flexor longus pollicis, the flexor sublimis digitorum, the flexor profundus digitorum excepting the divisions to the ring and little fingers, the median and ulnar nerves, and the ulnar artery; multiple tenorrhaphy and neurorrhaphy.*

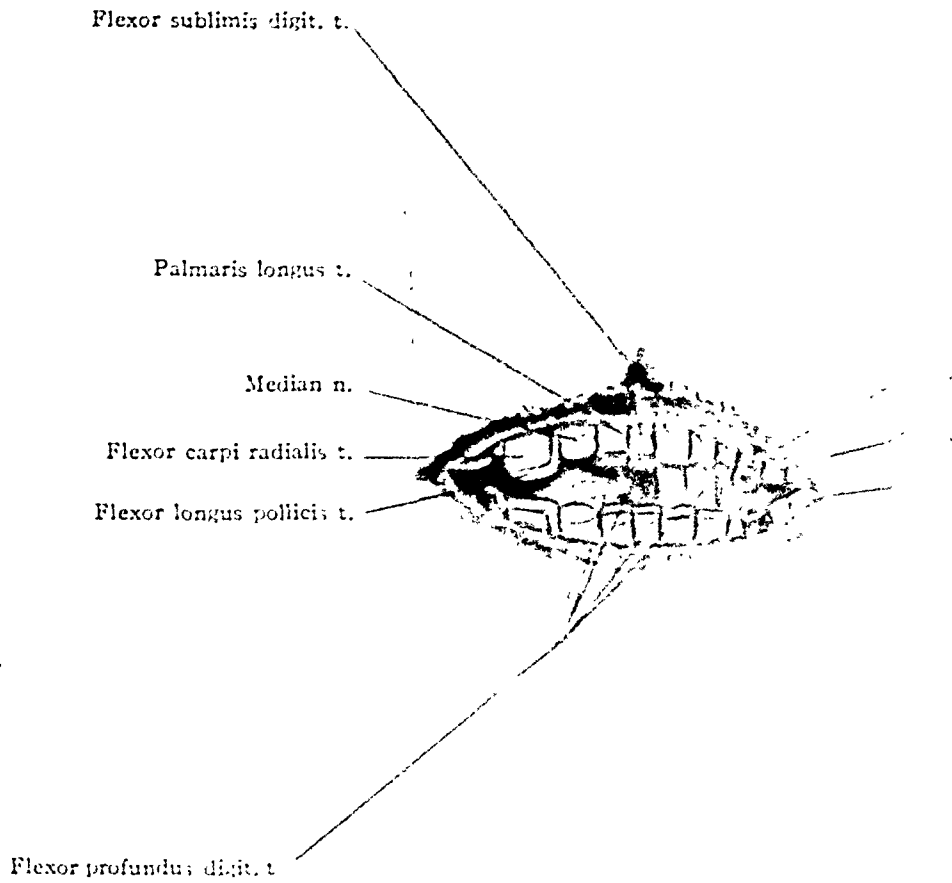
F. N., thirty-seven years of age, machinist. While at work the patient fell a distance of about 15 feet onto a skylight, the latter breaking, and he received an incised wound of the right wrist in addition to other injuries. Admitted to St. Mary's Hospital August 3, 1910. Treated by Dr. Wolf, Resident Physician. Ether anæsthesia.

Examination on admission showed a transverse lacerated wound about two inches in length of the flexor surface of the right forearm about one inch above the hand. Separation of the edges of the wound showed complete division of the flexor carpi ulnaris, the palmaris longus, the flexor carpi radialis, the flexor longus pollicis, the flexor sublimis digitorum, the flexor profundus digitorum excepting the divisions to the ring and little fingers of the latter; division of the median and ulnar nerves; and of the ulnar artery.

The forearm was thoroughly cleansed with soap and sterile water and alcohol 70 per cent. The wound was then irrigated with hot normal salt solution. The wound was then enlarged; the divided tendons were united separately with interrupted sutures of No. 1 chromicized catgut; the ulnar artery was ligated, and the divided ends of the median and ulnar nerves were separately united with through-and-through interrupted sutures of No. 1 chromicized catgut. The wound was then closed by interrupted sutures of silkworm gut. A dry sterile dressing was applied, and the hand and fingers placed in a position of marked flexion. The wound did nicely until the fourth or fifth day, when it was necessary to remove several sutures on the radial side of the wound, and it was found that there was a moderate degree of suppuration present which eventually resulted in a partial sloughing of the tendon of the flexor longus pollicis and separation of the cut ends. At the end of three weeks the wound had entirely healed. The patient has had very thorough and efficient massage since leaving the hospital, and is now at work.

Examination March 30, 1911, showed very little atrophy of muscles, extension of the fingers was good, excepting that of the distal phalanges; extension of the thumb was limited by the fixation of the distal end of the flexor longus pollicis at the wrist, and flexion was absent for the same reason; and in addition it was apparent that the site of suture had given way, and the cut proximal end had retracted. Flexion of the fingers was good in all, but was still somewhat diminished in the ring and little fingers. Complete flexion was limited by adhesion of the tendons at the site of the injury. Trophic changes were still present, although rapidly diminishing on the fingers; the flexor surface of the fingers felt cold, also tips on extensor surfaces, skin was atrophic, and nails were slightly roughened and longitudinally striated.

FIG. 11.



Showing the median nerve and its relation to the tendons of the flexor digitorum profundus and superficialis.

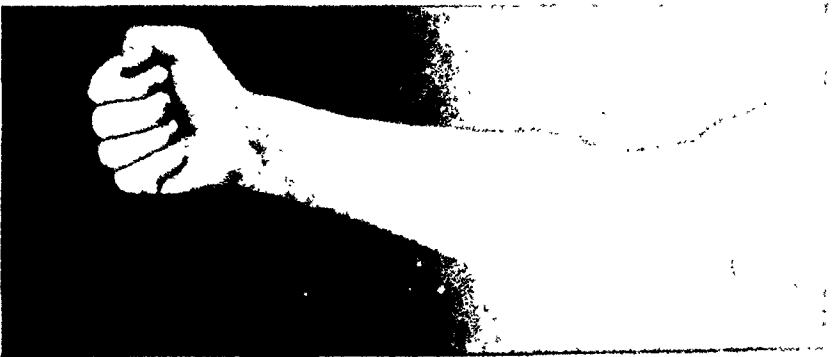


FIG. 12.



Showing the degree of extension possible in the forearm.  
(Caldwell).

FIG. 13.







The most common cause of incised and lacerated wounds of the extremities is from machinery accidents, gunshot wounds, explosions, cuts from scythes, glass, and sharp cutting instruments. In these accidents there is not only division of the superficial structures, but generally also division of muscles, tendons, blood-vessels, and nerves. In addition to the injury of the special structures there is very frequently, in lacerated wounds, a considerable destruction of the skin.

On first examining these wounds many problems are to be considered, dependent upon the extent of the wound and the structures involved. In the severe lacerated and incised wounds, where formerly amputation was the justifiable procedure, to-day entire parts are saved, useful limbs are preserved, and good functional results obtained by suture of muscles, blood-vessels, nerves, and tendons. Very frequently considerable judgment is necessary to come to the best possible conclusion, and in some cases operative procedure should be delayed on account of the shock so frequently present in many of these cases. Our primary interference should be limited to moderate cleansing, the removal of imbedded portions of clothing and foreign bodies, the ligation of small arteries, and an antiseptic dressing applied to the parts until the patient has thoroughly recovered from shock.

One of the most important problems in the treatment of these wounds is that of infection introduced at the time of the accident, either from the patient's clothing, his skin, or from the foreign body that produced the wound. Another very important consideration is the period that has elapsed from the time in which the wound was received and the time of seeing the patient. These two points have a great determining factor in the production of infection. In the treatment of these wounds they must all be generally considered as infected. We, however, know that very many of them can be thoroughly cleansed, and that they will heal by primary union. This is especially so of incised wounds. It is only from experience that we learn which ones should be drained, and which will probably heal without drainage. The chief infections to be

feared are tetanus, streptococcus, gas bacillus, and staphylococcus forms. The great determining factors in the production of infection are the condition of the parts, clothing, and trauma at the time of the injury. A secondary determining factor in the extent of infection is the amount of the destruction of tissue produced by crushing. In addition to infection the most dangerous immediate effect of these wounds is hemorrhage. Fortunately to-day our means of combating hemorrhage are very efficient, and in the use of normal saline solution by hypodermoclysis, proctoclysis, intravenously, and in the more urgent cases by direct blood transfusion we are generally able to meet all of these cases successfully, if the patient is seen early enough and there is not too great a degree of shock present.

In many of these wounds the chances of primary union are not good unless they are caused by clean, sharp cutting instruments and thorough cleansing of the parts is instituted. In a large majority the edges of the wound are primarily grossly infected, crushed, and devitalized, and in spite of the most thorough cleansing, dirt and grease cannot be entirely removed from the skin, and the edges of the wound in its entire depth have been so badly devitalized that either sloughing occurs in clean wounds or the resistance of the parts has been so lowered that infection readily occurs. An interesting form of treatment in these cases is that suggested by Reclus, who prefers never to irrigate with antiseptic solutions, who does not advise primary closure of the wound, and who dresses the wound with antiseptic ointment of vaseline 300, antipyrine 5, boric acid 3, salol 3, iodoform 1, carbolic acid 1, bichloride of mercury 10. He irrigates the wound with hot water under high pressure and then places the above ointment directly to the wound. In the treatment of these wounds I think that the best results are to be obtained from the following methods: thorough washing with soap and water, shaving the entire part, a second washing with soap and water using a firm brush, then washing the parts with alcohol 70 per cent. for two minutes, and in cases where the skin is covered with grease or

any other oily substance to wash with ether. The wound should be thoroughly irrigated with hot normal saline solution, all foreign particles removed, and all badly soiled and devitalized tissue should be cut away with a sharp knife.

After the above cleansing has been performed, a careful examination of the wound should be made for divided muscles, tendons, blood-vessels and nerves. The thorough approximation of these structures, especially the last two, is very important. Very often it will be found necessary to enlarge the superficial wound and to make a rather extensive dissection before the divided ends of all of the cut structures can be found. When deliberate suture has been performed, drainage of the wound must depend upon the degree of soiling by infectious material, the length of time that has elapsed since the accident, the amount of pressure destruction of the edges of the wound, and its position. The importance of a careful search for cut structures cannot be too greatly emphasized. How frequently do we see cases of comparatively trivial superficial wounds, in which division of important tendons and nerves has not been recognized until the resulting paralysis and atrophy call our attention to the nature of the injury!

# OBESITY AND ITS SURGICAL TREATMENT BY LIPECTOMY.\*

BY H. EDWARD CASTLE, M.D.,  
OF SAN FRANCISCO, CAL.

It is a well-known fact that fat when in excess fails to perform the function for which it is intended, and becomes a burden to the life of its possessor. Adipose tissue has for some of its functions the preservation of the body, and the formation of beauty by producing symmetrical outlines. It fails to protect its possessor when it accumulates to such a degree that he is unable to perform the duties of life without extra exertion. When the inactivities of age begin to come to a person, his sedentary habits are greatly enhanced if he is endowed with an excess of fat. Thus the vital organs concerned in the metabolic processes of the body are incapacitated, and as the intake of food often remains the same, the result is, unfortunately, an increase of body weight.

If the adiposity is generally distributed we can do nothing but properly regulate the diet, exercise, hygiene, and general physical condition of the patient. Such patients are, obviously, not in the realm of the surgeon. They are subjects of the internist and should receive his careful attention. These patients are not interesting; there is very little to stimulate a scientific interest; they need constant attention to prevent them from regressing into their former modes of living, thereby undoing all that has been accomplished; and they are often discouraged at their slow progress. The result of this unfortunate fate is they read of and hear of advertised remedies and men who can reduce their weight rapidly, and they become martyrs to injurious chemicals and are the subjects of extortion by fraudulent men.

There is another class of patients to treat who are suffering

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\* Read before the Society of the San Francisco Polyclinic and Post-Graduate School, August 2, 1911.

from excess of fat. In these there are large localized areas of fat that can be removed to the advantage of its possessor. After discarding lipomas there are still collections of adipose tissue that are very detrimental to the welfare of the one to whom such belong. This is strikingly realistic in the abdomen of many people. Persons so afflicted cannot take the proper exercise; gymnastics and walking fatigue them so rapidly they do not get enough of either to be of much avail. The excess of weight often breaks down the arches of the feet, which condition is frequently associated with varicose veins of the legs, and ulcers. Sedentary habits are thus enhanced with sequelæ of incompetent liver, constipation, myocardial changes, etc. The contour of the body is unsightly, which keeps the individual out of society, and, if it chances to be a woman, induces her to wear harmful corsets to mold the form into a presentable appearance. The great weight outside of the centre of gravity gives her a mien which is ungraceful and embarrassing. Eczema is prone to appear in the folds during hot weather.

Some of these unfortunate individuals have been relieved by a surgical removal of the pendulous abdomen. There remains a large number of people so afflicted who would submit to extirpation of the excess of such circumscribed areas of fat if their surgeons would suggest it and advise them as to its ultimate benefits.

The operation is of the most simple form in surgery and consists of an elliptical incision which encompasses the amount of tissue to be removed, and which extends down to the deep fascia. The area thus marked out can quickly be shaved from the deep fascia. We find the most useful instrument for this purpose is a medium size amputating knife. After ligating all bleeding vessels, the superficial fascia should be closed with catgut sutures and the edges of the skin brought together by interrupted silkworm gut. These sutures should be placed about one inch apart and about one centimetre from the edge of the skin. Very accurate apposition of the skin is very desirable, and is best brought about by a continuous horse-hair suture carefully placed. The greater the heed to this detail

the more ready will be the healing of the wound. If due attention be paid to the closure of the wound, the scar will not be too unsightly and the convalescence will be much more agreeable to both patient and surgeon. The wound should be dressed with gauze which has been moistened with boric acid solution; this enhances the capillary attraction of the dressing and is a potential factor in relieving post-operative pain. If the binder which is destined to hold the dressings in place be drawn moderately snug the pain will be reduced to a minimum. It is easy to estimate the amount of tissue to be removed by endeavoring to approximate the fingers of the two hands when the mass is between them. If there is any tension on the sutures it can be relieved by flexing the body by the aid of a back rest in the bed. Local anæsthesia is not preferable in these cases, as the incision is too great in length. It is better to use general anæsthesia, the choice being nitrous oxide and oxygen, if there are no contraindications to its employment.

The operation was first called to the attention of the profession in 1890 by Demars and Marx.<sup>1</sup> Professor Howard A. Kelly<sup>2</sup> reported a case in 1899. The work of these gentlemen did not receive wide publicity, for we are unable to find many cases reported. Maylard<sup>3</sup> in 1907, Schulz<sup>4</sup> in 1908, and Weinhold<sup>5</sup> in 1909, all published records of their cases. In 1910 Kelly<sup>6</sup> wrote again advising the operation, giving it the name of lipectomy, describing this simple technic and reporting a very illustrative case. In the same year he pointed out the applicability of lipectomy while operating on very fleshy patients in order to make it possible for the operator to gain closer access to deep-seated pelvic lesions.<sup>7</sup> Ballard<sup>8</sup> reported one successful case in 1910 and Oehlecker<sup>9</sup> in 1911; both performed lipectomy while operating for umbilical hernia. In the same year R. Jolly<sup>10</sup> described his method of removing the excess of fat from the abdominal wall and reported two cases. It is possible that other cases have been recorded, but, if so, they are few, and we have not been able to learn of them during a careful perusal of the literature. Then, too, there are undoubtedly a large number which have not been

published. It is the object of the writer in reporting this case to help in keeping this valuable operation in the minds of the progressive surgeons until it receives its deserved attention.

CASE I.—Lady, thirty-eight years old. A native of Sweden. Had had diseases of childhood. Menstruated at twelve years, irregular, and accompanied by pain. Married ten years; husband has nephritis. Two children; one is well; one has a nervous disorder which causes him to have incontinence of fæces when at work in school. Two years ago patient had a miscarriage which took place in the third month of gestation. Since this sickness she menstruates for ten days each month, during which time there is profuse flow. Patient is very constipated. She becomes fatigued and out of breath when taking the slightest exercise.

*Physical Examination.*—Heart action very irregular; this irregularity is markedly increased during exercise. Patient is 5 feet 3½ inches in height, and weighs 300 pounds. The adipose tissue is abundant in the abdomen and in the breasts, effecting a very awkward position while standing and extreme labor while walking. Both legs have large varicose veins below the knees; midway between the ankle and the knee on the anterior and the anterolateral surfaces of the right leg is a varicose ulcer which is 7 cm. in diameter. Trendelenburg's test for function of the valves in the internal saphenous veins shows they are competent.

The patient was sent to the hospital for Schede's varicose vein operation and Kelly's lipectomy.

*Preparation of Patient.*—Forty-eight hours prior to operation the ulcer and leg were cleansed with soap and water, then dressed with a gauze dressing which had been moistened in a solution of bichloride of mercury the strength of which was 1:10,000. The evening immediately preceding the morning of operation the abdomen and back were cleansed and covered with sterile, dry gauze.

*Operation.*—Under ether anæsthesia both legs were operated for varicose veins after Schede's method. The abdomen was painted with three coats of tincture of iodine. An incision beginning three inches laterally from the spinous process of the





## BOOK REVIEWS.

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The contents of this treatise are divided as follows: posterior vaginal cœliotomy; anterior vaginal cœliotomy; simple vaginal hysterectomy; indications and limitations in disease of adnexa; hysterectomy for myomata, submucous, deep interstitial tumors, and intraligamentous growths, hysterectomy and technic with indications for vaginal Cæsarean section.

The distinctive character of the work is the technic of the several operations discussed.

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After reading the book one is impressed with the conscious confidence and finality of its teachings, and admiration for the elegance of its diction.

Probably the subject of posterior vaginal cœliotomy comes first in point of value and ability. The usefulness of this procedure is of the highest importance in the ascites of peritoneal tuberculosis, and within certain limitations, paradoxical as it may appear, makes this form of tuberculosis easily curable. Again

first lumbar vertebra was made to traverse the anterior abdominal wall above the umbilicus, ending on the opposite side at a point analogous to the point of origin. The ends of this incision were joined by a second incision traversing the anterior abdominal wall a few inches above the pubis. The tissue composing the area thus outlined was removed from the deep fascia by the employment of a medium size amputating knife. The skin was closed as advised above. The line of suture was reinforced by silkworm tension sutures placed about three inches apart and including in their grasp the entire coats of the abdominal wall which were external to the deep fascia. These sutures were introduced one and one-half inches on either side of the suture line. Drainage was effected on either side of the body at the most dependent part, and the wound dressed with a large, moist boric acid dressing.

*Subsequent History.*—Schede operation healed without incident. The ulcer healed rapidly under scarlet-red ointment treatment.

During the three succeeding days following the operation the wound in the abdomen exuded a large amount of serum. Healing was *per primam*. The stitches were removed the ninth day after operation, and the wound supported by a collodion dressing. Patient walked out of the hospital the thirteenth day. During the time she was in bed she received no nourishment except water and three glasses of milk per day. Since her convalescence her diet has been carefully selected so that she has gained none of the 65 pounds which she lost during operation and starvation. She now claims to feel better when at work than she formerly did when at rest. The accompanying photographs depict her condition before and after operation.

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- <sup>1</sup> Demars and Marx: *Le progrès médical*, 5, iv, 1890.
- <sup>2</sup> Kelly: *Proc. Johns Hopkins Bulletin*, vol. x, 1899, p. 197.
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- <sup>5</sup> Weinhold: *Zentral. fur Gyn.*, Sept. 18, 1909, p. 1332.
- <sup>6</sup> Kelly: *Surg., Gyn., and Obst.*, March, 1910.
- <sup>7</sup> Kelly: *ANNALS OF SURG.*, March, 1911, p. 364.
- <sup>8</sup> Ballard: *Oklahoma State Jour.*, Nov., 1910.
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the author gives proper emphasis to its value in pelvic abscess. Whenever there may be uncertainty as to pus being in the peritoneal cavity or in the connective tissues lateral or posterior to the uterus, the procedure is equally wise and valuable.

Posterior cœliotomy for delivery of uterus and for removing ovarian cysts after Dührssen's method is warmly advocated.

While the author refers to Prior's most useful practice concerning this route in pelvic peritonitis, he dismisses it without further comment.

The subject of anterior vaginal cœliotomy is reviewed in quoting the views of German authorities, as Sanger, Zweifel, Dührssen, Kuster from 1888 to 1905, and in 1896 of Wertheim in devising vaginal fixation and shortening of the round ligaments.

He also quotes American authorities in the use of the anterior vaginal route, mentioning Boldt's operation for vaginal hysterectomy in 1887, and Goff's early adoption of this route for retroversion, retroflexion, and conservative operations on the adnexa, together with myomectomy for fibroids and operations for ectopic gestation.

He fortifies his claim to the superiority of anterior vaginal cœliotomy by Abel's acknowledgment that abdominal operations are easier than vaginal, who also states his early objections to the vaginal route were due to the fact that he did not understand its technic.

Notwithstanding his sincere, forceful advocacy of the advantages of anterior cœliotomy, he is equally positive in the reasons for which it is contraindicated. Among these are pregnancy, involvement of the appendix, of co-existing necessity of exploring the gall-bladder, large irregular fibroids, intraligamentous tumors, hæmatomas high up, etc.

While it is impossible to go into detail of other operations recommended, that of vaginal Cæsarean section is entitled to more than passing notice. "We are able," he says, after Dührssen, "with the aid of vaginal Cæsarean section in all normal pelves, and in such pelves whose conjugate is not less than 7.5 or 8 cm., at any period of pregnancy or labor even without pains and a completely closed cervix, to empty the uterus of its contents within a few minutes." This is radical obstetrical surgery not likely to come into general use by the average obstetrician, but with a field of usefulness well established and likely to be enlarged in proportion as the confidence and technical ability of the accoucheur expand.

In no part of the splendidly illustrated treatise are the various types in operative procedure better shown than in that of the vaginal Cæsarean section, or their utility better enforced.

One point in the technic of most of these operations which challenges a reason for its adoption is the nearness to the external os—at which the operator begins his inverted double incisions.

Finally it may be stated that while the clearness and logic of the writer cannot be gainsaid, it is hardly probable that its teaching in the main will in any great extent influence many operators to abandon their preference for an abdominal coeliotomy.

WALTER B. CHASE.

DIAGNOSTIC AND THERAPEUTIC TECHNIC. By ALBERT S. MORROW, M.D., Adjunct Professor of Surgery in the New York Polyclinic. W. B. Saunders Co., Philadelphia and London, 1911.

The author has incorporated in this volume a large number of the procedures employed in the various methods of diagnosis and also of treatment. While some of the methods detailed belong essentially to the domain of the specialist, the majority are practical procedures which the general practitioner, and especially the hospital interne, may be called upon to perform at any time.

The plan of the work comprises, first, a description of certain general diagnostic and therapeutic methods and, second, a description of those measures employed in the diagnosis and treatment of diseases affecting special regions and organs of the body.

All procedures are given in detail, thus obviating the necessity of referring back to other portions of the text; this, however, causes unavoidable repetition which does not in any way detract from the value of the book.

The illustrations are well drawn and profuse. The present work deserves especial recommendation for the general knowledge which it conveys.

INDUCED CELL-REPRODUCTION AND CANCER. By HUGH CAMPBELL ROSS, M.R.C.S., L.R.C.P., with the assistance of JOHN WESTLEY CROPPER, M.B., M.Sc., M.R.C.S., L.R.C.P. P. Blakiston's Son and Co., Philadelphia, 1911.

This is a study in the isolation of the chemical causes of normal and augmented, asymmetrical human cell-division. It is a fascinating story of research along new lines, dealing with the microscopic study of living cells. Incidentally one

gets a view of the discouragement which British officials in India and Egypt throw in the way of the medical officers, to prevent their carrying on serious medical work. Dr. Ross has the courage to specify the Director-General of the Public Health Department of Egypt as such an official. This gentleman objected to Dr. Ross doing scientific work during his spare time, and also prevented his continuing his mosquito campaigns because he apparently did not believe in them; nor was Dr. Ross permitted to publish the results of his work. He left the Egypt service and continued his studies at the Royal Southern Hospital in Liverpool. His early discouragements at the hands of officialdom were not unlike those of his distinguished brother, Ronald Ross.

The investigators studied living cells in nutrient media under the microscope, and observed the means by which they could be made to divide and multiply at the will of the observer. With living cells in agar, they applied stains and various other substances, and observed their effect. As soon as a stain reached the nucleus of a cell it died.

Cells absorb all absorbable substances; they do not seem to have a selective power; they take out of the surrounding medium whatever is there, whether it is poisonous to them or not. Against this it may be offered that in therapeutics we observe that certain cells respond to certain substances and others do not. Ross and Cropper show that strychnine, for example, stimulates certain cells of the nervous system; but it is absorbed by all cells. It causes amoeboid movements in leucocytes, but this gives rise to no gross symptom and passes unnoticed. A cell may absorb two substances, one of which is fatal to it and the other of which stimulates cell-division: it starts to divide and perishes in the process.

Experiments were made upon living blood-cells with aniline products, alkaloids, ptomaines, nucleins and glandular extracts. The proliferation of leucocytes and lymphocytes as a process of wound healing, it is shown, is caused by kreatin and xanthin. It has been supposed that the cell-proliferation of healing was due to the inherent propensity on the part of the cells to divide; but these observers have made it clear that division occurs when the cell has absorbed a definite amount of a chemical agent. Two of these agents are kreatin and xanthin, both of which are products of dead tissue, liberated by cells which have perished. When death



of cells takes place, then the neighboring cells cannot resist the absorption of these substances, and they proliferate.

Another substance which stimulates proliferation is globin, a histone derived from hæmoglobin. Hæmoglobin, it is shown, has a distinct action in causing proliferation of the malarial parasite. The most rapidly growing cancer is melanotic sarcoma; and the development of sarcoma in the presence of blood-clot or destroyed cells is well known.

Concerning leucocytes, the authors say that for nearly a century and a half these cells have been observed in the blood, but no one has heretofore seen them in process of division. Now, if they are made to absorb certain chemical agents, they divide immediately; and, what is more, the rapidity of onset and the time occupied by each division varies directly with the quantity of the substance absorbed. Cell-division seems to be a physical phenomenon which can be measured in the case of each cell in proportions of the amount of the chemical auxetics absorbed by them. It can be reduced to a mathematic equation. A wound produces the remains of dead tissues, containing kreatin and xanthin, and proliferation of leucocytes occurs in the presence of these agents. The cell-proliferation in healing is proportionate to the extent of cellular death: much destruction, much repair.

These investigators go on to show this common chemical cause of cell-proliferation. The spermatozoa furnish the extractives which start proliferation in the ovum. Globin applied to chronic ulcers stimulates cell-proliferation greatly. An alkalioid of putrefaction, like choline, it is shown, must be the cause of lymphadenoma. In connection with this latter statement, it is interesting to note that Trousseau, in 1872, stated that lymphadenoma often follows on a focus of suppuration.

In experimenting with epithelial cells, it was found that they could not be made to live long *in vitro*, and experiments were difficult. It was assumed that, as cancer is peculiar to that period of life when the dead cells in the body increase, it is a phenomenon similar to those already discussed. Normal blood-serum was found to contain a body which has a restraining effect upon all division induced by auxetics. It was found that 1 c.c. of serum contained in 10 c.c. of gelatin, which also contained 1 c.c. of a 1 per cent. solution of choline, stopped the kinetic action of these in exciting amœboid movements. The experimenters tried to increase the amount of this inhibiting body in cancer patients by injecting an augmented auxetic combined with blood-serum. Six

ounces of defibrinated sheep's blood were injected per rectum once daily. The serum contains the restraining body; and it was assumed that the red cells would be destroyed in the rectum, the hæmoglobin decomposed and the globin augmented by the action of bacteria. The products in this combination, being absorbed, it was thought, might act as a sort of vaccine.

This treatment the authors report having applied to several cases with good results in most of them. In the cases most carefully studied the tumor was made to disappear. The criticism should be offered that more cases should have been studied before publishing this report. It is of value in throwing light upon the cause of cell-proliferation. To these authors, perhaps, belongs the credit of having shown the cause of normal human cell-division, and possibly the cause of malignant cell-proliferation also. Whether the therapeutic measures which are suggested shall be of value remains to be seen.

JAMES P. WARBASSE.

PRACTICAL CYSTOSCOPY. By PAUL M. PILCHER, A.M., M.D., Brooklyn, N. Y. 8vo, pp. 398. W. B. Saunders Co., Philadelphia and London.

A work on cystoscopy in English has been much needed. Dr. Pilcher's book supplies this need in a most satisfactory manner. The arrangement of the work is excellent, the text clear and concise, the illustrations, with liberal descriptive legend, are unusually instructive, and the work as a piece of bookmaking reflects credit upon the publishers.

The subject matter is divided into seven parts.

Part I deals with the types and construction of the various cystoscopes now in use, the electrical devices for supplying illumination, the technic of conducting the examination both in the male and female. The diagrams and illustrations to aid in interpreting objects seen through the different types of cystoscopes are excellent. There are many practical suggestions in regard to conducting the examination which are of much value to beginners. The technic of ureter catheterization is clearly described and illustrated. The difficulties encountered and the means at our command for overcoming these difficulties are well put.

Part II deals with the pathological conditions of the bladder as seen by the cystoscope. The various diseases are sufficiently described, and with the numerous excellent illustrations accompanying the description the different diseases should be recog-

nized, one from the other, with less practical experience than was heretofore necessary.

Part III deals with diseases of the prostate. Here the method of recognizing the different diseases of this organ and the special forms of prostatic hypertrophy are described and illustrated. Diseases simulating prostatic diseases symptomatically are mentioned and their differential characteristics noted.

Part IV deals with diseases of the ureters. The methods of recognizing the diseases of these structures by means of the ureter catheters and the Röntgen rays are considered. The important information to be derived from distending the ureters with solutions of silver salt in connection with Röntgen ray examination might perhaps have received more consideration.

Part V is devoted to the consideration of the methods of determining the functional activity of the kidneys. The different tests are described and their relative value discussed. The exact details of technic are insufficient for those with no knowledge of the subject, and the student must consult original articles or other sources for this detail instruction, some of which original articles are designated by footnote.

Part VI considers the many different means of diagnosis of the various diseases of the kidney. Helpful illustrative cases are cited. The value and methods of local therapeutic measures are here considered. Semi-diagrammatic illustrations showing the pathological conditions and the appearances of ureteral orifices in the different diseases are most valuable.

Part VII describes briefly but sufficiently the important operative procedures which may be carried out by special cystoscopic instruments and devices.

Considering the work as a whole, Dr. Pilcher's book must be considered complete, well balanced in regard to the amount of space devoted to the different subjects, the arrangement excellent, and text and illustrations cannot be too highly commended. The index is most satisfactory. The book is typically American and has no superior in any language.

JOHN H. CUNNINGHAM, JR.

PLASTIC AND COSMETIC SURGERY. By FREDERICK STRANGE KOLLE, M.D. New York, D. Appleton and Company, 1911.

The historic references in this book are of much interest. The author falls into the vernacular of the past and exclaims, "With-

al, it is a noble, generous art, worthy of far more extensive use than it now enjoys."

In the pages of the book which are devoted to the author's special field, we find descriptions of plastic and cosmetic operations, which the surgeon may study, with satisfaction. The descriptions of the various incisions for plastic work are the best to be found in surgical literature. In all operations, the early removal of sutures is recommended in order to prevent scar. On the face the stitches are removed in from twenty-four to forty-eight hours.

The author's operation for reducing the size of the ear is ingenious. His operation for malposition of the auricle is effective.

The operations for hair-lip are fully described. Incisions to meet every possible condition are illustrated. The same is true of the operations for restoration of the lips.

The use of paraffin in prosthetic surgery is fully and well discussed in all its aspects. Twenty-two possible untoward results are described, and means for their prevention given. The technic of injections is minutely described. A complete classification of the conditions which may be remedied by paraffin prosthesis is presented, together with the technic for each operation. The large possibilities of this branch of surgery are made clear by this book, and its mastery made possible.

All of the methods of rhinoplasty, which are worthy of consideration are presented. The methods are well described and illustrated. Especial consideration is given to the securing of bony or cartilaginous supports for the soft plastic flaps. The methods suggested are most helpful. Cosmetic rhinoplasty is so well described that ethical surgery might hope to rescue this field from the quacks.

This book is of especial value to the surgeon who is skilled in the principles of his art. He can refer to it with satisfaction when seeking information on the plastic surgery of the head, face and neck. It is a useful work, and in its special field fills a place in surgical literature.

J. P. WARBASSE.

COLLECTED PAPERS BY THE STAFF OF ST. MARY'S HOSPITAL, MAYO CLINIC. Volumes I and II. Octavo. Volume I, pages 668; Volume II, pages 633. W. B. Saunders Company, Philadelphia, Pa., 1911.

These two fine volumes present the papers and reports made by the staff of St. Mary's Hospital, of Rochester, Minn., from

1905 to 1911. Naturally the great bulk of the volumes is from the pens of the two senior members of the staff, Drs. William J. and Charles H. Mayo. In Volume I, out of seventy-three papers, Dr. William J. is to be credited with fifteen papers, and Dr. Charles H., with twelve. In Volume II, of sixty-three papers, Dr. William J. is to be credited with twelve and Dr. Charles H. with seven. When one observes that Volume II is the output from this clinic of a single year, the growth in the activity of the work is especially noticeable.

These papers have been read before various medical societies and are brought together in their present form for convenience of reference. More than that, however, in their collected form they constitute a magnificent monument to the scope of the work carried on in the Mayo Clinic, and to the industry, breadth and progressiveness which characterize that clinic.

The volumes are published with full Indices, both of authors and of subjects, so that reference to their contents is greatly facilitated. They are abundantly illustrated.

In running through these volumes one cannot fail to feel a certain personal note significant of the relations of the directors of this clinic to their whole work. These volumes form the beginning of a personal surgery of the highest character and of the greatest value. It is to be hoped that for many years to come successive volumes of the same character will appear.

THE TREATMENT OF FRACTURES, With Notes Upon a Few Common Dislocations. By CHARLES LOCKE SCUDDER, M.D. Seventh Edition, Revised and Enlarged. Octavo. Pages 708. W. B. Saunders Company, Philadelphia, Pa., 1911.

The successive editions of this book during the past ten years have received notice from time to time in the ANNALS OF SURGERY. It has been very interesting to note the steady growth in the scope and quality of the book. Its dominant note still remains that of treatment, and the number and character of the illustrations still remain a most attractive and valuable characteristic. The author has a genius for illustration, so that in turning over the pages of the book one seems to be in the presence of the author, demonstrating the particular condition under consideration. In the present edition it is to be noted that new material has been added, especially upon fractures of the skull, fractures of the spine, fractures of the neck of the femur, and injuries to the lower end of the tibia. A chapter on

the operative treatment of fractures has also been added. The attitude toward the operative treatment of fractures by the author is a very properly conservative one, such as every surgeon believes in, "that operative treatment of fractures is desirable, provided the indications for operation are clear." "The majority of simple or closed fractures can be satisfactorily treated by non-operative methods. Each individual case should be judged on its own merits." "It must ever be kept in mind that a very definite indication for operation must be present before an individual case is submitted to the additional risk of incision and direct fixation." These ideas we think will meet with general acceptance among surgeons. In their application, however, naturally there will be differences due to the different experiences, opportunities, and aptitudes of different surgeons.

Dr. Scudder's book has grown until it is no longer merely a hand-book, but it has become a portly volume of reference and occupies a worthy place among the very best books in its special field. We have put it on our shelf by the side of Hamilton, Stimson, Gurlt, and Hoffa.

LEWIS S. PILCHER.

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## CORRESPONDENCE.

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### NEEDLES FOR ARTERIAL ANASTOMOSIS.

EDITOR, ANNALS OF SURGERY:

Will you be so good as to call attention to an error in printing in the article "The Technic of End-to-End Arterial Anastomosis?" On page 489, the line "needles, No. 6 Kirby sharps" should read: "needles, No. 16 Kirby sharps."

Yours truly,

Boston, Mass.

ALBERT EHRENFRIED.

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# ANNALS OF SURGERY

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## ORIGINAL MEMOIRS.

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### THE VALUE OF THE LEUCOCYTE COUNT IN ACUTE SURGICAL DISEASES.

BY HERBERT W. HEWITT, M.D.,

OF DETROIT, MICH.

WITHIN the last decade leucocyte counting in acute surgical diseases has acquired a new meaning, due largely to the recognition of the value of the differential count. For many years total counts only were made, and these yielded but little information, as their significance was not well understood. An ordinary furuncle might produce a high count, while a severe general peritonitis might reveal a leucopænia, and these facts could not be satisfactorily explained. Since a more complete blood picture has been utilized in the study of this class of diseases, valuable information as to the diagnosis and prognosis has been made available. The limitations of all laboratory work, however, must be recognized. The laboratory alone cannot, save in exceptional instances, make a diagnosis for the physician. The clinical findings must be correlated with those from the laboratory, and this is especially true of blood work in acute surgical diseases. It is necessary to carefully exclude all other conditions which might cause a departure from the normal.

For the purpose of this paper it is essential to have, as a working basis, an average normal, not only of the total number of white cells, but also of the polymorphonuclear cells.

As the polymorphonuclear cells are principally affected in inflammatory diseases, they alone of the various types will be considered. Various writers give the average number of leucocytes considered normal from 6000 to 10,000, and the average normal percentage of polymorphonuclears from 60 to 80 as follows:

Sondern .....	6,700	68 per cent.
Von Limbeck .....	8,500	70-80 per cent.
Da Costa .....	7,500	60-75 per cent.
Gibson .....	10,000	75 per cent.
Hayem .....	6,000	
Tumas .....	6,200	
Graeber-Reineke .....	7,242	
Boeckner-Halla .....	7,533	
Thoma .....	8,687	

If 10,000 is taken as the maximum number for the total count and 75 per cent. as the highest percentage for polymorphonuclears, the average normal will probably not be too low. The total count of itself is of little value, as it is influenced by many factors. These may be classified as follows:

A. Physiological leucocytosis: (1) leucocytosis of new born; (2) leucocytosis of digestion; (3) leucocytosis of pregnancy; (4) leucocytosis after parturition; (5) leucocytosis of violent exercise; (6) leucocytosis of cold baths and massage; (7) terminal leucocytosis.

B. Pathological leucocytosis: (1) post-hemorrhagic; (2) inflammatory; (3) toxic; (4) malignant disease; (5) due to therapeutic and experimental influences.

Then, too, in severe infections which are poorly resisted, a low total count is frequently observed; while in mild infections well borne, a high total count may be found.

The differential count, on the other hand, is of much greater value, since this is, as a rule, uninfluenced by physiological factors, and the changes due to the pathological conditions are more definitely defined. When both total and differential counts are taken and the relation each bears to the other is considered, the assistance rendered in the diagnosis and prognosis of the disease in question possesses a value



vastly greater than either of the less complete and unrelated observations.

Surgery deals with general rules, and not with absolutisms, and there are exceptions to nearly all rules. The following statements, however, may be considered as general rules:

1. The total count is an index of the patient's resistance to the infecting organism.

2. The relative polymorphonuclear count is an index of the degree of, or the severity of, the infection.

3. If we have a relative polymorphonuclear count ranging between 75 per cent. and 80 per cent., infection is probable; if between 80 per cent. and 85 per cent, infection is usually found; if above 85 per cent., infection is almost invariably encountered, and this regardless of the total number of leucocytes. In fact, some laboratory workers do not make use of the total count at all, but depend for diagnosis entirely upon the differential count.

A few points can usually be decided by reference to both counts, namely:

(a) bodily resistance, whether high or low; (b) infection, whether severe or mild; (c) infection whether well borne or poorly resisted; (d) infection, whether circumscribed or un-circumscribed (*e.g.*, appendiceal abscess).

Gibson<sup>1</sup>, of New York City, speaks of the relative disproportion between the differential and total counts, and considers that "bodily resistance is more clearly defined by this disproportion than by any other means at our command, and that of all methods of blood examination, this is the most valuable, both from a stand-point of diagnosis and prognosis."

Dr. Gibson has suggested the use of the chart in order to more clearly show this disproportion. He assumes 10,000 as the maximum normal for the total number of leucocytes and 75 per cent. as the highest percentage of polymorphonuclear cells to be considered normal. He further assumes that, "In inflammatory lesions which are well borne, the

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<sup>1</sup> The Value of the Differential Count in Acute Surgical Diseases, ANNALS OF SURGERY, 1906, pg. 485.

polymorphonuclear cells are increased 1 per cent. above 75 per cent. for every 1000 of the total leucocytes above 10,000." Upon this basis he has made some interesting observations.

Chart I shows a typical Gibson chart.

CHART I.

35,000	.....	100
30,000	.....	95
25,000	.....	90
20,000	.....	85
15,000	..	80
10,000	.....	75

An infection which is well resisted will show a parallel line, or else a line the obliquity of which will run toward the leucocyte side of the chart (see Chart II.) If the line runs about level, whether high or low, it indicates that a lesion, whether severe or not, is well borne and therefore of good prognosis.

The obliquity of the lines determine the prognosis in a given case.

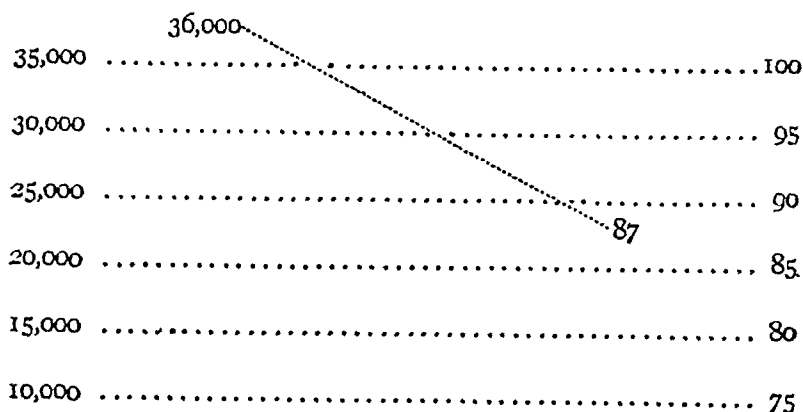
Chart II shows the count in a case of acute suppurative appendicitis placed upon the Gibson chart. In this case there is a slightly falling line, but it shows that the infection is well resisted. Patient recovered; infection, colon bacillus.

CHART II (Case No. 66).

35,000	.....	100
30,000	.....	95
25,000	.....	90
20,000	.....	85
17,200	.....	80
15,000	.....	80
10,000	.....	75

Chart III shows a case of pelvic abscess. We have here a favorable condition for operation, as the line runs from the leucocyte side downward with a marked degree of obliquity. Result, recovery, with no unfavorable symptoms.

CHART III (Case No. 80).



Gibson states that all of his fatal cases showed a rising line. In our series, four revealed a slight falling line. It is important in this connection to take into consideration, as suggested by Fowler,<sup>2</sup> the duration of the disease, because we know that where infection is severe resistance is in time overcome, and then our counts will be of little value.

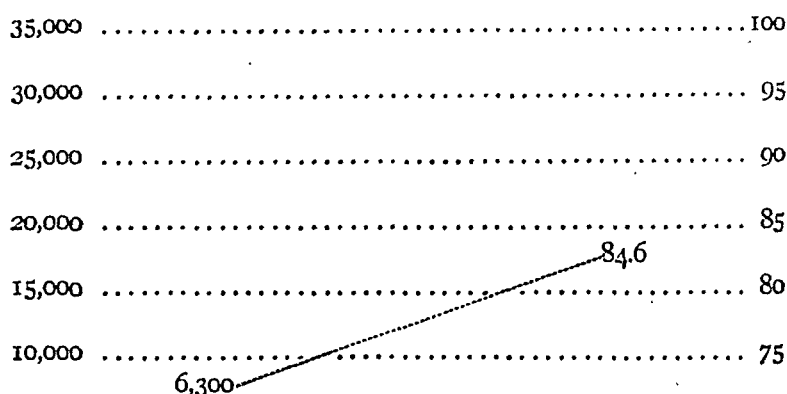
Chart IV shows a case of general peritonitis (diagnosis confirmed by autopsy). The very low total count and the marked deviation upward of the line toward the polymorpho-nuclear side of the chart make this a case where the prognosis is exceptionally unfavorable.

I wish to report 100 cases taken from Dr. Metcalf's and my own private records. The cases are all of the acute inflammatory type, and all have been brought either to operation or autopsy, so that the diagnosis has been either confirmed or disproven. In a number of cases many counts have been made, but the count made immediately before the operation has been the one used in this series. No one will deny that repeated counts are of much greater value in diagnosis than

<sup>2</sup> The Relation of Appendicitis to the Leucocyte Count, Surgery, Gynecology and Obstetrics, Sept., 1908.

one isolated count. This point is especially emphasized by Gibson: "The importance of a disproportionate increase of polymorphonuclear cells, particularly if progressive, cannot be overestimated, and those wilfully disregarding such evidence are perhaps not exhausting all resources available for diagnosis."

CHART IV (Case No. 42).



The cases may be classified as follows:

Acute catarrhal appendicitis.....	13
Acute suppurative appendicitis (circumscribed).....	10
Acute suppurative appendicitis (uncircumscribed).....	9
Acute perforative or gangrenous appendicitis .....	6
Acute pyosalpinx .....	12
Pelvic abscess .....	18
Puerperal sepsis .....	13
Pelvic lymphatic infection .....	3
General peritonitis .....	5
Acute cholecystitis .....	4
Stitch abscess .....	3
Abscess of kidney .....	1
Abscess of parotid gland .....	1
Subphrenic abscess .....	1
Infected ectopic gestation (ruptured).....	1
<b>Total .....</b>	<b>100</b>

The appendicitis cases are interesting, and we have come to depend on the leucocyte count as an important factor in the diagnosis and prognosis of this disease.

Thirteen catarrhal cases show:

Average total count..17,907	Average polymorphonuclear .83%
Highest total count..33,000	Highest polymorphonuclear .90%
Lowest total count... 8,900	Lowest polymorphonuclear .73%

Six cases of perforative and gangrenous:

Average total count..19,517	Average polymorphonuclear .89.16%
Highest total count..30,000	Highest polymorphonuclear .90%
Lowest total count...13,500	Lowest polymorphonuclear .83%

Nine cases of suppurative (uncircumscribed):

Average total count..18,051	Average polymorphonuclear .89.8%
Highest total count..27,700	Highest polymorphonuclear .98.6%
Lowest total count.. 5,900	Lowest polymorphonuclear .81%

Ten of circumscribed abscess:

Average total count..19,049	Average polymorphonuclear .86.75%
Highest total count..36,200	Highest polymorphonuclear .97%
Lowest total count... 9,100	Lowest polymorphonuclear .78%

Closely allied to this group are the cases of acute pyosalpinx, puerperal sepsis, and pelvic abscess.

Of pyosalpinx, there are twelve cases with the following data:

Average total count..15,133	Average polymorphonuclear .83.3%
Highest total count..31,660	Highest polymorphonuclear .89%
Lowest total count...6,300	Lowest polymorphonuclear .67%

Of puerperal sepsis, thirteen cases:

Average total count..16,315	Average polymorphonuclear .81.5%
Highest total count..26,200	Highest polymorphonuclear .98%
Lowest total count...12,300	Lowest polymorphonuclear .76%

Of pelvic abscess, eighteen cases:

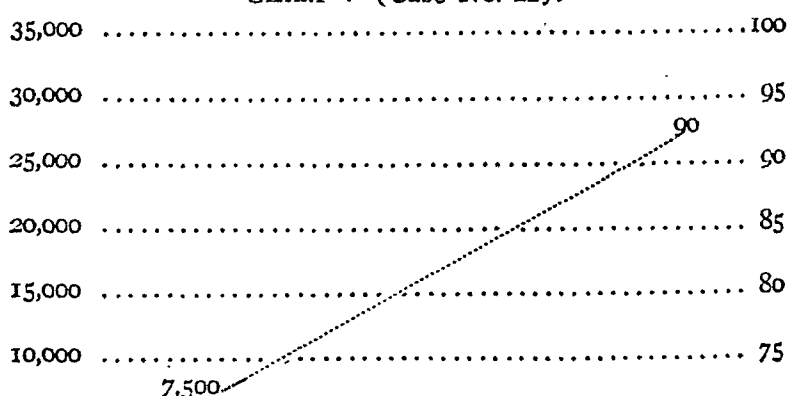
Average total count..20,005	Average polymorphonuclear .83.3%
Highest total count..31,000	Highest polymorphonuclear .91%
Lowest total count...10,200	Lowest polymorphonuclear .70%

Four cases of cholecystitis show averages very high:

Average total count..20,055	Average polymorphonuclear .92.4%
Highest total count..33,920	Highest polymorphonuclear .97%
Lowest total count... 7,500	Lowest polymorphonuclear .90%

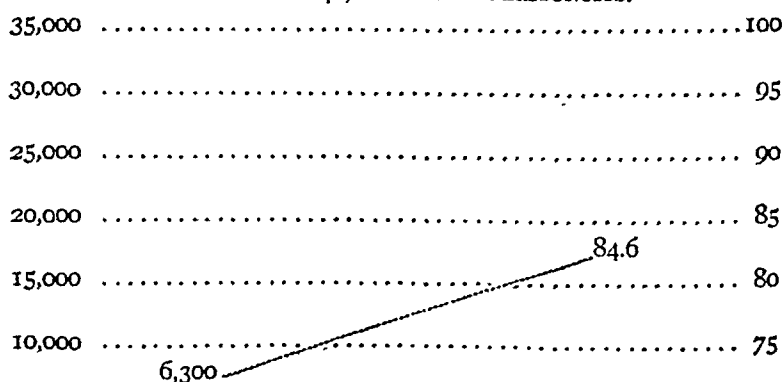
The case of acute suppurative cholecystitis (Chart V) is the only one in our series that revealed such a sharp ( $15^{\circ}$ ) rising line on the Gibson chart, and still recovered. This was a case of a woman over seventy years of age, who was operated upon within two days after symptoms appeared. This count, indicates the low vitality of our patient, and an infection of marked severity.

CHART V (Case No. 22).



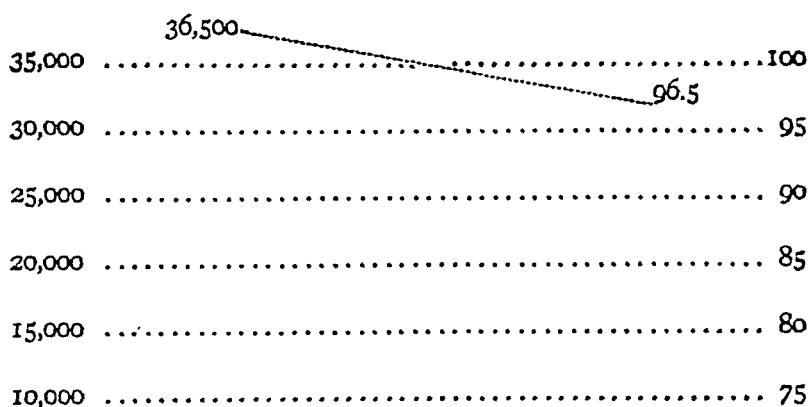
The five cases of general peritonitis all died, three showing a rising line and two a falling line, as shown in the accompanying charts.

CASE NO. 42, GENERAL PERITONITIS.



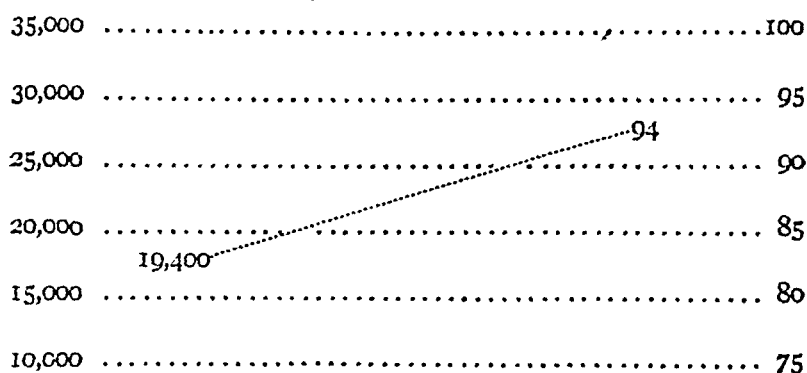
Three cases of stitch abscess are interesting to illustrate what a marked leucocytosis a small stitch abscess is capable of producing: Case 17, total count 16,200, polymorphonuclear 85.5 per cent.; Case 16, total count 25,000, polymorphonuclear 87 per

## CASE No. 55, GENERAL PERITONITIS.



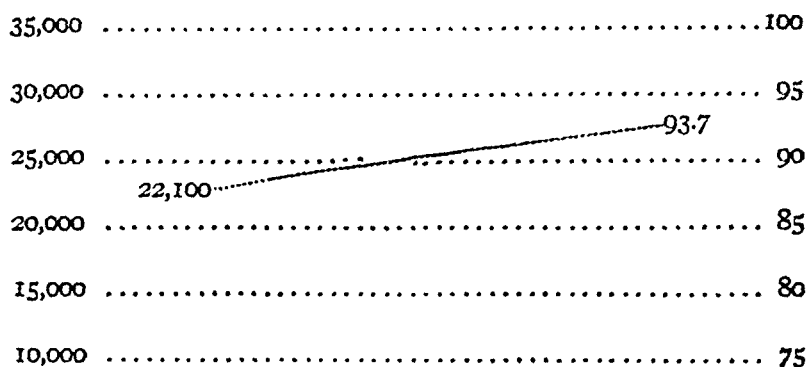
Fatal case, infection mixed, streptococcus predominating. Infection existing over short period of time only.

## CASE No. 70, GENERAL PERITONITIS.



Fatal case.

## CASE No. 84, GENERAL PERITONITIS.



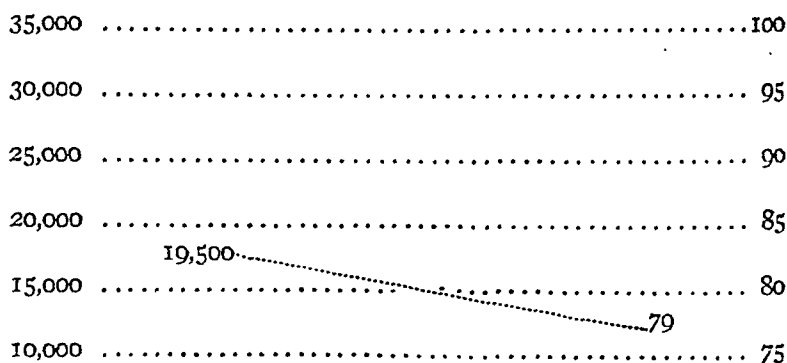
Fatal case.

cent.; Case 100, total count 23,400, polymorphonuclear 93.5 per cent.

The remaining cases may be tabulated as follows:

Pelvic lymphatic infection, three cases: Case 82, total count 22,100, polymorphonuclear 91 per cent.; Case 49, total count 11,200, polymorphonuclear 81.5 per cent.; Case 34, total count 7,800, polymorphonuclear 75 per cent.

#### CASE No. 89, GENERAL PERITONITIS.



Fatal case. Long continued infection.

Ruptured ectopic gestation (infected), one case: Case 77, total count 22,000, polymorphonuclear 87 per cent.

Subphrenic abscess, one case: Case 96, total count 35,000, polymorphonuclear 79 per cent.

Abscess kidney, one case: Case 48, total count 35,890, polymorphonuclear 91.5 per cent.

Abscess of parotid gland, one case: Case 50, total count 12,200, polymorphonuclear 91 per cent.

Our averages when classified according to the polymorphonuclear count may be arranged in the following order:

	Total	Polymorphonuclear
Pelvic lymphatic infection .....	13,866	82.3 per cent.
Acute catarrhal appendicitis .....	17,907	83 per cent.
Pelvic abscess .....	20,005	83 per cent.
Acute pyosalpinx .....	14,636	83.3 per cent.
Appendiceal abscess (circumscribed) .....	19,089	85.75 per cent.
Appendiceal abscess (uncircumscribed) .....	18,175	86.4 per cent.
Puerperal sepsis .....	16,315	86.9 per cent.
Stitch abscess .....	21,733	87.6 per cent.



	Total	Polymorphonuclear
Gangrenous and perforative appendicitis .....	19,516	89.1 per cent.
General peritonitis .....	20,564	89.5 per cent.
Acute cholecystitis .....	20,055	92.3 per cent.

It seems to the writer that these averages are significant. Excluding the counts in stitch abscess and puerperal sepsis, the following points are noted. In acute inflammatory diseases in the pelvis the polymorphonuclear counts are low. When we approach the appendiceal region the count is higher, but when we reach the "attic" of the abdomen our records show very marked increase in both total and polymorphonuclear counts.

A question that arises at this time is: "Can we place the percentage of polymorphonuclear cells at a certain number below which we do not expect to find infection?"

Sondern<sup>3</sup> has the following to say in this respect: "A relative percentage of polymorphonuclear cells below 70 with an inflammatory leucocytosis of any degree excludes the presence of pus or gangrene at the time the blood examination is made, and usually indicates good bodily resistance toward infection." Gibson cited three pus cases with polymorphonuclear counts below 70 per cent., and in my series I had one case (Case 27, acute pyosalpinx with adhesions and small pockets of pus among adhesions).

I do not believe that between 65 per cent. and 80 per cent. we can state with any degree of accuracy that the count *per se* means the presence of infection.

The writer believes that in acute inflammatory surgical diseases repeated counts at frequent intervals should be made, and if the polymorphonuclear percentage rises while the total number remains stationary or falls, immediate operation should be insisted upon.

In some cases we found that the leucocyte count did not help us in making a diagnosis, and in these cases we have dis-

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\*The Present Status of Blood Examinations, Medical Record, vol. lxvii, pp. 452-455.

regarded the blood findings entirely and depended upon the history and physical signs, but in cases where the count has been positive its value could not be easily underestimated.

Leucocyte counts are sometimes valuable for their negative findings, *e.g.*, they are frequently of assistance in making a diagnosis between a small ovarian cystoma with a twisted pedicle and a pyosalpinx or appendicitis. Dr. Metcalf operated upon a case illustrating this. A very large woman with thick abdominal wall was suddenly seized with pain over McBurney's point and vomited. Tension of muscle and tenderness were present in the right lower quadrant of abdomen. Temperature and pulse were normal. Vaginal examination revealed nothing positive. Diagnosis, small ovarian cyst with a twisted pedicle, right side, or acute appendicitis. Blood count revealed 8590 leucocytes with 62 per cent. polymorphonuclears. Diagnosis after blood count, ovarian cyst with twisted pedicle, and this was confirmed by laparotomy.

The counts enumerated in this paper were made by Drs. Safford, Torrey, and myself, and a uniform technic was followed.

I wish to acknowledge my indebtedness to Dr. Metcalf for the perusal of his case records, and to Drs. Safford and Torrey for assistance rendered.

#### CONCLUSIONS.

1. The laboratory findings must be correlated with the clinical to be of any value at all.
2. The total count alone is insufficient.
3. The differential count, *per se*, is of value in diagnosis, but of little value in prognosis.
4. The total and differential counts, when taken together and correlated with the clinical findings, are frequently of great value both in diagnosis and prognosis.
5. No definite percentage of polymorphonuclear cells can be taken to positively indicate infection. If we have a percentage of between 75 and 80 of polymorphonuclear cells,

infection is probable; if we have a percentage of between 80 and 85, infection is usually found; if we have a percentage above 85, infection is almost invariably encountered.

6. The negative value of the count is sometimes very useful in diagnosis.

7. The duration of the infection must be taken into consideration.

Counts are more positively diagnostic when taken early in the course of an acute surgical disease. Infection will frequently, when of long duration, overcome the patient's resistance and so vitiate the value of the count.

# THE TRANSPLANTATION OF FREE FLAPS OF FASCIA.

AN EXPERIMENTAL STUDY

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INTRODUCTION.—For some time I have been interested in the methods brought forward for replacing and for reinforcing weakened or defective tissues, and while some of the methods are admirable, all are limited in their application. It seemed worth while to search for a material which would accomplish the same purpose but would have a wider field of usefulness.

In looking about for some suitable tissue in the body which was easily obtainable, which had considerable strength, and at the same time was sufficiently flexible for any desired need, I was led to try the experimental transplantation of free flaps of fascia.

After proceeding with the experiments for some time I found that some excellent work had already been done along this line.<sup>1</sup> However, my results were sufficiently suggestive to warrant a report on the subject, in order to again call attention to this promising surgical procedure.

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<sup>1</sup> Kirschner, M.: Ueber freie Sehnen-und Fascien. Transplantation, Beitr. z. klin. Chir., 1909, lxxv, 472.

Günther: Ueber Duraplastik: eine klinisch-experimentelle Studie, Beitr. z. klin. Chir., 1910, lxxix, 740.

Hohmeier: Ueber ein neues Verfahren zur Deckung von Trachealdefekten, München. med. Wchschr., 1911, Bd. lvi, 948.

Since this paper was handed in for publication the following experimental-clinical articles have appeared. They will be considered fully in another report.

Hohmeier, F: Experimente über Verschluss von Wunden und ueber-

Sixty-two experiments were done on 39 dogs. Ether anæsthesia was used in each experiment.

*Technic.*—The part was shaved, washed with green soap and water, then with alcohol and ether. After the skin was thoroughly dry it was painted with tincture of iodine 2.5 per cent. The iodine solution was also freely used in the open wounds and after suture of the skin.

Fine black silk was the ligature and suture material used throughout. The wounds were closed in layers wherever possible. The skin was closed in every instance with the button-hole stitch.

Dry sterile gauze secured by a bandage was used wherever dressings were applied.

The fascia was obtained, for the most part, from the thigh, the iliotibial band of the fascia lata being the most satisfactory portion to work with, as it is easily separated from the underlying tissues. In a few instances the strong abdominal fascia was employed.

The fascia was transplanted in both single and double layers and in one or two instances was twisted.

In each experiment where adhesions were not desired the fascia lata (iliotibial band) was placed with the inner or muscle surface exposed. For example, when a flap of fascia was placed in a peritoneal defect, the muscle or smooth side was turned toward the peritoneal cavity, and it was found that dense adhesions were less likely to occur than when the outer side was turned toward the cavity.

In this series, unless otherwise stated, the fascia was transplanted into the same animal from which it was taken.

An attempt was made to place free flaps of fascia on the various tissues, in order to test its vitality and obtain an idea of its possibilities for clinical use.

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brückung von Defecten Schleimhauttragender Körpercanäle und-höhlen durch freie auto-plastic, Arch. f. klin. Chir., 1911, 345.

König, F.: Neue Wege der plastischen Chirurgie. (Verschluss und Ueberbrückung), Arch. f. klin. Chir., 1911, 326.

Lewis, D. and Davis, C. B.: Experimental Direct Transplantation of Tendon and Fascia, J. Amer. Med. Assn., lvii, 1911, 540.

*Experiments.*—For convenience I have divided the series into eight groups. To economize space I will only report a few of the typical experiments in each group.

*Group I.—Transplantation of Free Fascia into Subcutaneous Tissue, on Fat; on Muscle; Periosteum, on Naked Bone; Cartilage, Tendons and Ligaments.*

EXPERIMENT 6.—Male, black mongrel; about nine months old. *Operation*, November 22, 1910: A piece of fascia lata was sutured in the subcutaneous tissue of the chest wall. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

February 23: Distemper. The animal was sacrificed. *Autopsy.*—The fascia was somewhat thickened but otherwise it seemed normal. It was strong and tough.

*Histology.*<sup>2</sup>—Microscopic examination showed apparently normal fascia with fibres and nuclei clearly stained. No degeneration.

EXPERIMENT 7.—Female, white fox terrier; about six months old. *Operation*, November 28, 1910: The sartorius muscle was exposed and a broad band of fascia lata was sutured snugly around it. The wound was closed in the usual manner. No dressing. Condition on leaving the table excellent. *Per primam* healing.

January 16, 1911: Animal sacrificed. *Autopsy.*—The fascia was somewhat thickened but otherwise it seemed normal. The fascia band could be easily stripped from the muscle.

*Histology.*—Microscopic examination: the sections showed normal fascia with no signs of degeneration.

EXPERIMENT 8.—Female, tan mongrel; about six months old. November 29, 1910, a flap of fascia lata was removed from the thigh and wrapped in moist salt gauze and then placed in the ice box in a sterile jar.

*Operation.*—December 1, 1910: The fascia which was placed in the ice box forty-eight hours ago was sutured on the ribs, under the muscle. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

January 24, 1911: Animal sacrificed. *Autopsy.*—The fascia was thickened but otherwise it seemed normal. It was movable on the ribs.

*Histology.*—Microscopic examination: the sections showed normal fascia with clearly stained nuclei and fibres.

EXPERIMENT 9.—Male, black and white fox terrier; about two years old. *Operation*, December 1, 1910: The right femur was exposed and the periosteum was stripped back for about 2 cm. Into this defect a band of fascia lata was sutured around the bone. The wound was closed in the usual manner. No dressing. Condition on leaving the table excellent. *Per primam* healing.

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<sup>2</sup>I take this opportunity of thanking Dr. C. D. Deming for assistance in the histological examinations.

December 27: Death from pneumonia. *Autopsy*.—The band of fascia was somewhat thickened and was intimately blended with the periosteum on either side. The structure of the fascia could be plainly seen.

*Histology*.—Microscopic examination: the sections showed normal fascia with no signs of degeneration.

EXPERIMENT 43.—Female, white mongrel; about two years old. *Operation*, March 14, 1911: The trachea was exposed and a large flap of fascia was sutured on it. This fascia had been removed from another animal on February 7, 1911, and had been in cold storage since that date. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

April 10: Death from distemper. *Autopsy*.—The fascia was somewhat thickened but otherwise it seemed normal. It was closely adherent along the margins and seemed to blend with the tissues on the surface of the trachea.

*Histology*.—Microscopic examination: the sections showed normal, well-nourished fascia.

*Comment*.—In this group free fascia flaps were successfully transplanted into the subcutaneous tissue, into fat, on muscle, periosteum, bone, cartilage, tendons, and ligaments.

Microscopic examination of the specimens showed that the fascia retained its own structure after transplantation and was apparently healthy and well nourished. This was true even after being kept in cold storage for 35 days and then transplanted into another animal.

The clinical uses suggested by these experiments are of considerable importance, and cover a wide field.

*Group II.—Transplantation of Free Fascia into Tendon and Muscle Defects.*

EXPERIMENT 16.—Male, black mongrel, about six months old. *Operation*, December 19, 1910: The right tendo Achillis was exposed and a section about 2.5 cm. long was removed. The stumps were held in position by a strong tension suture, and then a flap of fascia lata was placed in the defect so as to surround the stumps like a tube. This tube was then drawn tight and the ends were securely sutured around the stumps. The tension suture was cut and the dead spaces obliterated. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

March 7, 1911: Distemper. Sacrificed. The animal had been very active and had no limp. It was impossible to tell which leg had been operated on without close inspection. *Autopsy*.—The replaced tendon was thicker than normal but seemed strong and satisfactory in every way (Fig. 1).

*Histology*.—Microscopic examination: cross section of the new tendo

Achillis showed normal staining fascia which was folded on itself. Surrounding the fascia was connective tissue, which caused the apparent thickening of the new tendon.

**EXPERIMENT 20.**—Male, white fox terrier, about four months old. *Operation*, January 3, 1911: The sartorius muscle was exposed and a section about 2.5 cm. long was removed. The muscle ends were held in position and a flap of fascia lata was sutured into the defect surrounding the muscle stumps by a tube of fascia. The dead space was obliterated and the wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

February 1: Death from pneumonia. Since the healing the animal had been very active and no difference could be detected in the gait. *Autopsy.*—The fascia was firmly united with the muscle ends (Fig. 2).

*Histology.*—Microscopic examination: the sections showed fascia with fibres and nuclei clearly stained.

*Comment.*—This group shows that muscle and tendon defects may be bridged by free flaps of fascia. Muscle defects may be bridged by means of fascia flaps and thus a certain amount of the muscle function saved. The fascia united firmly with the muscle ends and formed a strong symmetrical band between them.

The use of fascia flaps to replace tendons is of especial importance and most promising clinically. While it is a well-known fact that free tendon transplantation can be successfully done, it must be borne in mind that it is often difficult to secure either long or short pieces of tendon without doing considerable damage.

There are large amounts of fascia available in the body which can be secured without damage to any other working part. Thus tendons of any desired length might be made from strips of the iliotibial band of the fascia lata.

Experimentally the tendons made of folded strips of fascia are not liable to adhere to surrounding tissues. Fascia flaps might also be used to prevent tendons from being caught in scar tissue. The final results after replacing tendons with this material are more satisfactory than with any foreign material or transplantable tissue with which I am familiar.

*Group III.—Transplantation of Free Fascia Around Vessels and Nerves.*

**EXPERIMENT 33.**—Female, black and yellow mongrel, about one year old. *Operation*, February 14, 1911: The right jugular vein was dis-

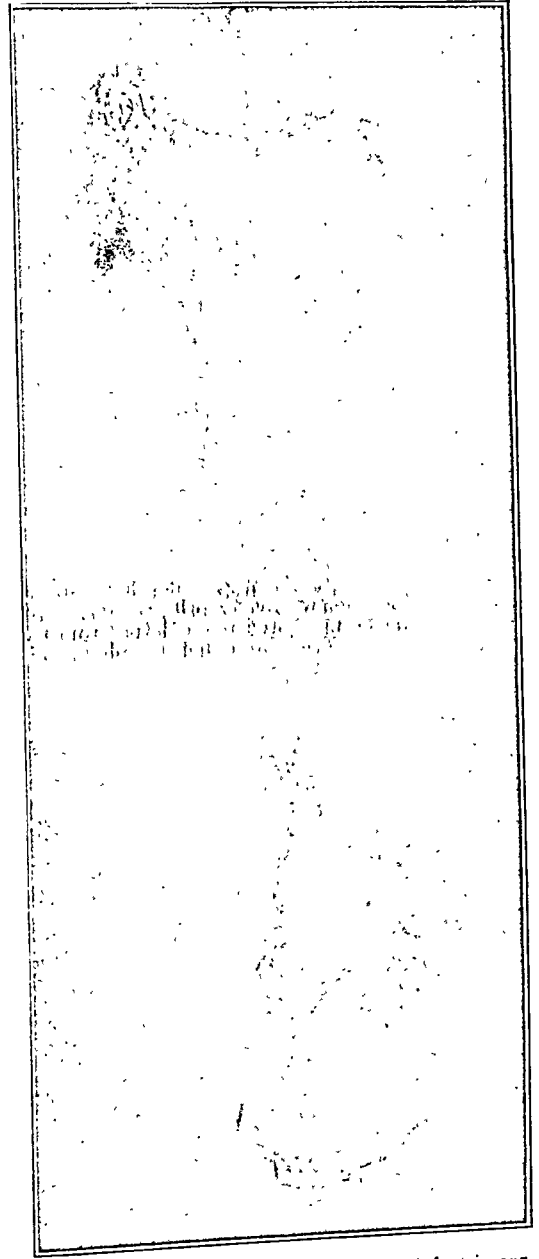


FIG. 2

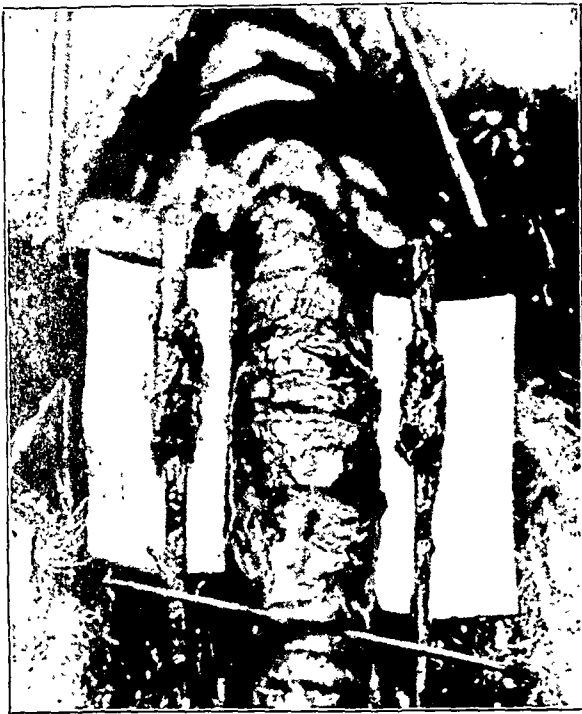
FIG. 1.



Experiment 16.—Fascia to replace tendo Achillis. Operation, December 19, 1910. Specimen removed March 7, 1911. Comparison of new and normal tendons. The new tendon is thicker than the normal.



Experiment 20.—Fascia replacing defect in sartorius muscle. Operation, December 27, 1910. Specimen removed January 14, 1911. The thick muscle ends can be seen, and connecting them is the fascia which has united firmly to them.



Experiment 41.—Fascia around vessels and on trachea. Operation, March 14, 1911. Specimen removed April 11, 1911. On the right carotid can be seen a flap of fascia which was transplanted immediately from the same animal. On the left carotid and trachea are flaps of fascia from another animal which had been in cold storage for 35 days.

FIG. 4.



Experiment 22.—Fascia filling defect made by removal of patella. Operation, January 9, 1911. Specimen removed February 2, 1911. Note the amount of extension and flexion possible. The fascia can be seen firmly healed to the joint capsule.

sected out and a flap of fascia lata was wrapped about it. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

March 3: Death from pneumonia. *Autopsy*.—The fascia was thickened but otherwise seemed normal. It was quite adherent to the vessel wall. The lumen of the vessel was not encroached upon.

*Histology*.—Microscopic examination: the sections showed the structure of the vessel to be normal. It was surrounded by a band of fascia which was apparently well nourished and showed no signs of degeneration.

EXPERIMENT 41.—Female, yellow and white mongrel, about one year old. *Operation*, March 14, 1911: Both common carotid arteries were exposed. Around the right carotid a piece of fascia lata was sutured, which had just been removed from the right thigh. Around the left carotid was sutured a piece of fascia which had been removed from another animal on February 7, 1911, and had been in cold storage since that date. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

April 10: Death from pneumonia. *Autopsy*.—The fascia on both carotids was thickened, but otherwise seemed normal. The appearance of the two specimens was the same. The fascia was quite adherent to the vessels but could be stripped off. The lumen of the vessels was not encroached upon (Fig. 3).

*Histology*.—Microscopic examination: the sections showed apparently normal fascia in both instances. No signs of degeneration.

EXPERIMENT 44.—Male, black and white fox terrier, about one year old. *Operation*, March 21, 1911: The right sciatic nerve was exposed and a flap of fascia lata was sutured around it. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing. Gait unaffected.

April 20: Distemper, animal sacrificed. *Autopsy*.—The fascia was thickened but otherwise seemed normal. It could be moved on the nerve to a slight degree. There was no constriction of the calibre of the nerve.

*Histology*.—Microscopic examination: the sections showed a normal nerve surrounded by well-nourished, apparently normal fascia.

*Comment*.—This group shows that free flaps of fascia may be successfully transplanted around arteries, veins, and nerves, without in any way interfering with the lumen of the vessels or compressing the nerves.

Clinically, fascia flaps might be of use in protecting suture lines in vessel surgery and in reinforcing weakened areas in vessel walls. The site of nerve plastic operations might be surrounded and protected by such flaps. It might also be of use in protecting a nerve after it was freed from callus or scar tissue.

*Group IV.—Transplantation of Free Fascia into Joints and for Suturing Fractured Bones.*

EXPERIMENT 22.—Female, yellow mongrel, about six months old. *Operation*, January 9, 1911: The left patella was removed and a piece of fascia lata was substituted for it. The fascia was folded on itself so that its inner smooth surface was next to the joint, and also under the skin. It was sutured to the capsule and the wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

February 2: Pneumonia, animal sacrificed. The joint was freely movable and as far as could be seen had been as serviceable as the normal knee (Fig. 4). *Autopsy*.—The fascia was easily separated from the skin. It had adhered firmly to the joint capsule. On opening the joint the surface of the fascia was perfectly smooth. There were no adhesions. The fascia was slightly thickened.

*Histology*.—Microscopic examination: the sections showed a double thickness of apparently normal fascia. The staining of fibres and nuclei was well marked (Fig. 5).

EXPERIMENT 29.—Female, white fox terrier, about eight months old. *Operation*, February 6, 1911: The right knee-joint was opened and the entire articular cartilage was removed as thoroughly as possible. Then a piece of fascia lata was inserted and sutured over the denuded portion of the femur and well up under the patella. The joint was closed. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

February 27: Death from pneumonia. Since the dressing was removed the animal has been using the operated knee-joint without apparent discomfort. *Autopsy*.—The joint was movable. The fascia was slightly thickened. It was adherent to the denuded end of the femur but to no other portion of the joint. Its structure was well preserved (Fig. 6).

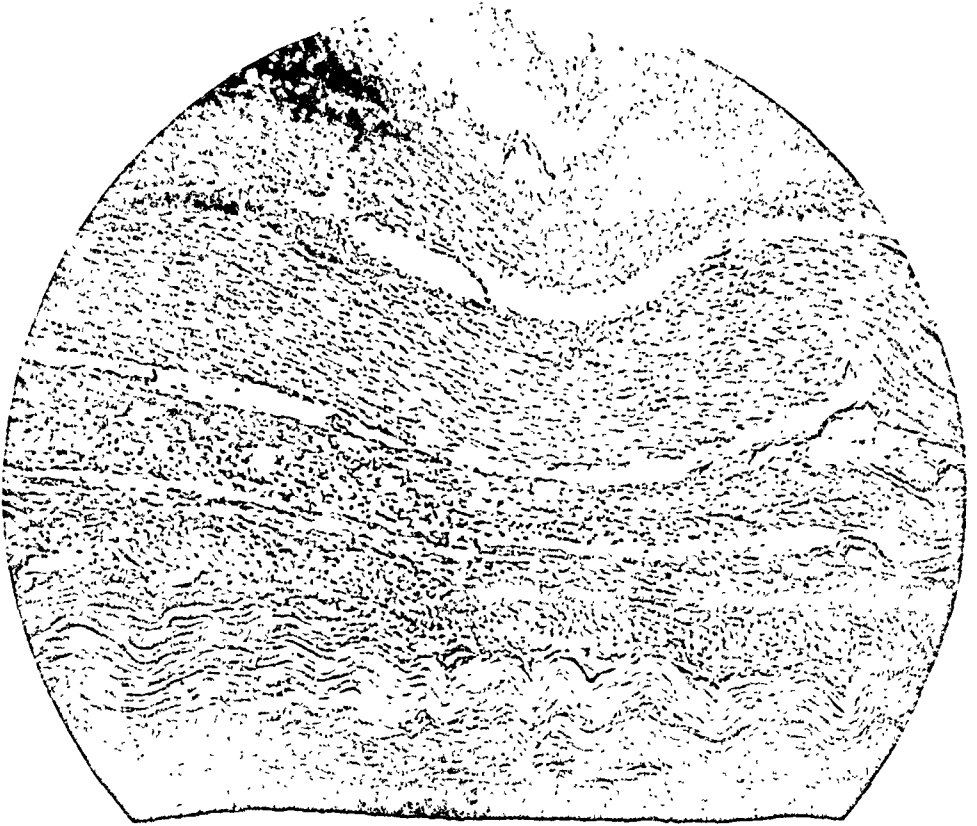
*Histology*.—Microscopic examination: the sections showed normal staining, well-nourished fascia. No signs of degeneration or absorption.

EXPERIMENT 31.—Male, yellow and white mongrel, about six months old. *Operation*, February 13, 1911: The right tibia was exposed and the periosteum stripped back. The bone was sawed through and then two strips of fascia lata were passed through drill holes and tied. The tied ends were made additionally secure by sutures. The wound was closed and a small drain inserted in the lower angle. Dry dressing, crinoline, and splint. Condition on leaving the table excellent. The stitches were removed on the fifth day. The wound was apparently nicely healed. It was practically impossible to immobilize the broken bone.

February 23: Distemper, animal sacrificed. *Autopsy*.—On removing the dressing the wound was found badly infected. In spite of the infection the strength of the fascia was apparently but little affected and the strips were still holding the ends of the bone together. This specimen was accidentally lost.

*Comment*.—This group is also interesting. Free flaps of fascia were successfully transplanted into joints and also to

FIG. 5.



(Microphotograph, Zeiss. Obj. AA. Oc. 3.) Two layers of fascia filling defect left by removal of patella. Section cut parallel to fascia bundles. The smooth, dark, staining layer at the bottom of the plate is the portion toward the joint cavity.

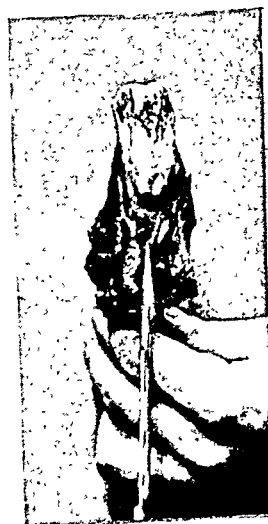
FIG. 6.



*a*



*b*



*c*

Experiment 29.—Fascia into joint after removal of the cartilage. Operation, February 6, 1911. Specimen removed February 28, 1911. (*a*) Leg extended, compared with normal; (*b*) leg flexed, compared with normal; (*c*) inside of joint. The + marks the operated joint.

FIG. 7.



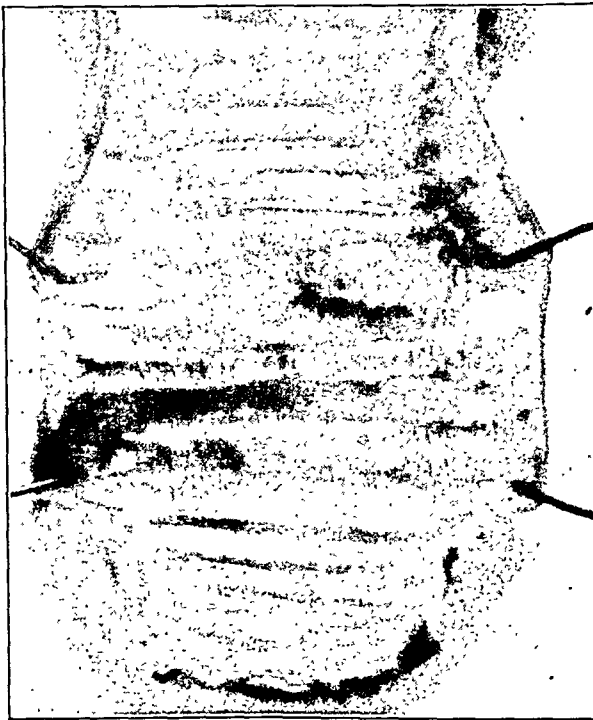
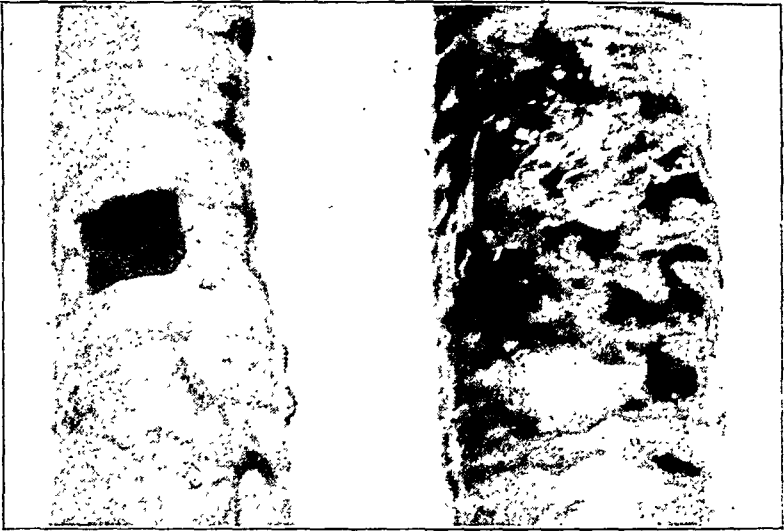
*a*



*b*

Experiment 38.—Fascia into skull and dura defect. Operation, March 6, 1911. Specimen removed April 20, 1911. (a) Bone defect from outside with fascia adherent to bone edges; (b) from within the outline of the bone defect can be seen. The fascia is closely adherent to the dura which extends beyond it. The fascia is smooth except for one small adhesion in the centre.

FIG. 8.



c

Experiment 62.—Fascia over defect in trachea. Operation, June 12, 1911. Specimen removed July 3, 1911. (a) Shows normal trachea with opening in it the size of that covered by the fascia; (b) the fascia healed over a similar defect; (c) the same specimen from within, showing a slight depression which marks the defect. The mucous membrane has grown completely over the fascia.



take the place of patellæ which had been removed. Both of these procedures are suggestive clinically.

Bones were fractured and the fragments sutured with strips of fascia. The results of these last experiments were unsatisfactory on account of the difficulty in immobilizing the fragments. However, the use of fascia strips in the open treatment of fractures in human beings may be of great use clinically, as immobilization can be secured.

The fascia does not act as a foreign body, and has strength enough to stand any reasonable strain put upon it.

*Group V.—Transplantation of Free Fascia into Defects in the Skull and Dura, also into Tracheal Defects.*

EXPERIMENT 38.—Male, yellow mongrel, about one year old. *Operation*, March 6, 1911: The left temporal muscle with the underlying periosteum was turned back and a three-quarter inch button of bone was removed. The dura under this area was excised and a flap of fascia lata was tucked under the bone edges. The smooth muscle side of the fascia was placed next to the brain. The temporal muscle was replaced and sutured, and the wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

April 20: Distemper, animal sacrificed. *Autopsy*.—There was one small adhesion of the cortex to the central portion of the fascia. The edges of the fascia and dura were intimately blended. The structure of the fascia could be plainly seen. The fascia was tightly stretched across the bone defect and was firm and did not bulge on pressure (Fig. 7).

*Histology*.—Microscopic examination: the sections showed normal staining, apparently well-nourished fascia.

EXPERIMENT 62.—Female, black mongrel, about one year old. *Operation*, June 12, 1911: The trachea was exposed and an area 8 mm. square was excised. Over this defect was sutured securely a flap of fascia lata. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing. There was no cough or any respiratory symptom following the operation.

July 3: Animal sacrificed. *Autopsy*.—The fascia was somewhat thickened and firmly adherent to the surface of the trachea. There had been no leakage whatever. On opening the trachea from behind, the defect was made out as a very shallow depression and the fascia seemed to be entirely covered with mucous membrane, which had grown over it (Fig. 8).

*Histology*.—Microscopic examination: the sections showed the defect filled by normal staining, apparently well-nourished fascia. Over this fascia, as a base, the mucous membrane had grown, completely covering it (Fig. 9).

*Comment.*—This group shows that flaps of fascia inserted in skull defects between the dura and bone edges will heal and give a strong membrane which will resist considerable pressure from within and without. When the dura is removed in addition to the bone, the fascia flap tucked under the bone edges will unite with the dura and also become tightly adherent to the bone edges.

There was in each instance a single fine adhesion of the cortex to the centre of the fascia flap.

Fascia flaps might be used clinically in repairing skull defects and as an aid in closing of spina bifida.

This group also shows that free flaps of fascia may be successfully used to cover prepared defects in the trachea, without subsequent infection, and that the mucous membrane grows across the fascia covering the defect.

It might be of use, clinically, in closing old tracheotomy wounds, where there has been considerable destruction of cartilage, and also in reinforcing sutures of the trachea.

*Group VI.—Transplantation of Free Fascia into Prepared Defects in the Abdominal Wall.*

EXPERIMENT 17.—Male, white and black fox terrier, about one year old. *Operation*, December 22, 1910. All the tissues of the abdominal wall between the skin and the peritoneum were excised from an area about 4 by 7 cm. Into this defect a flap of fascia lata 3 by 6 cm. was sutured. The skin was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

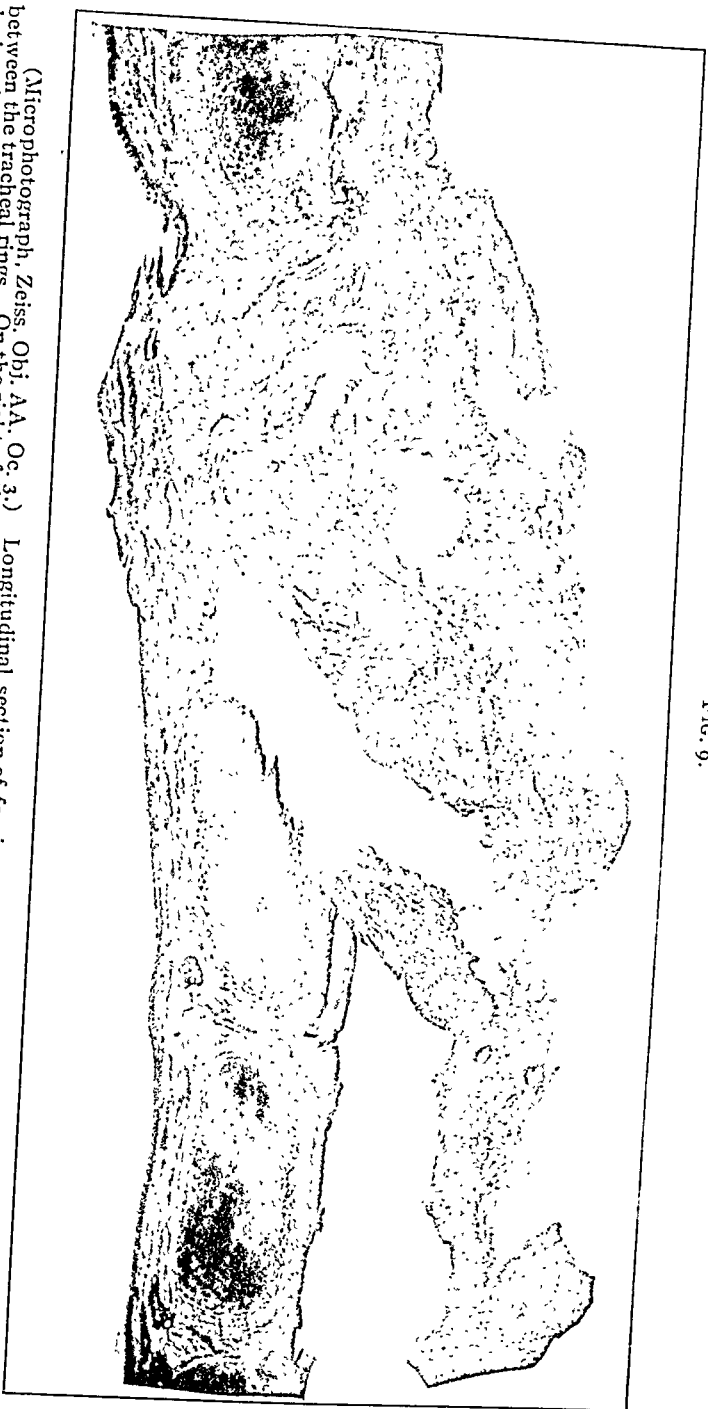
June 27, 1911: Animal sacrificed. *Autopsy.*—There was no hernia or bulging of the abdominal wall at the site of operation. From within there was no depression in the parietal peritoneum. On holding the specimen to the light the outline of the inserted fascia could be readily seen. The fascia itself was slightly thickened but normal in every way and was strong and tough.

*Histology.*—Microscopic examination: the sections showed normal staining fascia with no signs of degeneration.

EXPERIMENT 19.—Male, brown and black mongrel, about one year old. *Operation*, December 29, 1910: The peritoneum was exposed and an area 4 by 2 cm. was excised. Into this defect a piece of fascia lata was sutured. The wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

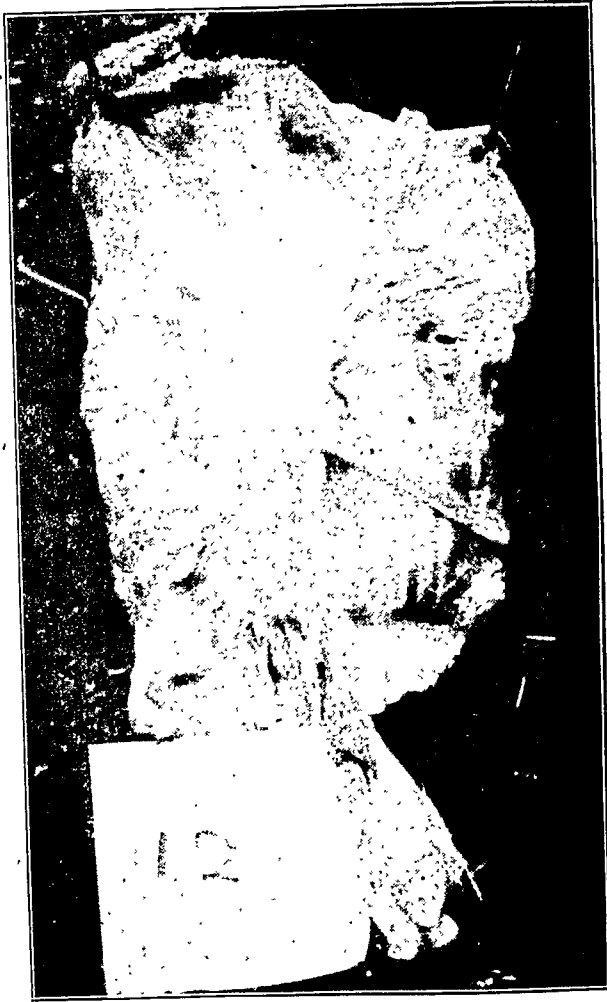
February 7, 1911: Animal sacrificed. *Autopsy.*—The fascia edges had blended with the peritoneum. It was thickened but otherwise seemed normal. There was a small omental adhesion.

Fig. 9.



(Microphotograph, Zeiss, Obj. AA, Oc. 3.) Longitudinal section of fascia covering a tracheal defect. The defect can be seen between the tracheal rings. On the right of the plate the fascia has become accidentally separated from the surface of the trachea during the preparation of the section. The mucous membrane can be seen covering the fascia.

FIG. 10.



a



b



c

Experiment 19.—(a) Fascia in peritoneal defect. Operation, December 29, 1910. Specimen removed Feb. 7, 1911. Experiment 23.—(b) Fascia on bladder. Operation, January 10, 1911. Specimen removed June 27, 1911. Experiment 61.—(c) Fascia over defect in intestine. Operation, January 5, 1911. Specimen removed July 3, 1911.

In all of these the fascia was thickened. It was incorporated with the peritoneum, and there was a puckering of the peritoneum at the margin of the fascia. There was adherent omentum in each case. A small tag can be seen

*Histology.*—Microscopic examination: the sections showed normal well-nourished fascia.

EXPERIMENT 46.—Male, yellow and white mongrel, about one year old. *Operation*, March 23, 1911: A section of the abdominal wall 3 by 7 cm., including everything except the skin, was excised. Into the peritoneal defect was sutured a flap of fascia lata from one thigh, and into the muscle defect, a flap from the other thigh. The skin was closed in the usual manner. Dry dressing. Condition on leaving the table excellent.

The animal developed distemper three days after the operation and on the fifth day the skin wound broke down. There was no hernia, as the fascia held firmly.

April 6: Death from distemper. *Autopsy.*—There was a crater-like ulcer, whose base was made up of fascia on which granulations could be seen both at the edges and scattered over the surface. There was no hernia whatever, and the fascia seemed to be strong and intact. On opening the abdominal cavity there was free pus, and this was also found in the pleural cavity. The omentum was adherent over a small part of the fascia. The fascia was incorporated with the peritoneum and had healed firmly in position.

*Histology.*—Microscopic examination: the sections showed infiltration with leucocytes, and marked signs of infection. The fascia was apparently in good condition with clearly stained fibres and nuclei. There was definite granulation tissue growing from the ulcer edges out on the fascia.

*Comment.*—This group shows that free flaps of fascia may be sutured into peritoneal and muscle-fascia defects in the abdominal wall, and that it will incorporate itself with the surrounding peritoneum and muscle edges. A small omental adhesion was present on examination of the specimen in each instance, but in no case was there adhesion of the gut or any other abdominal organ to the fascia.

When a hernia was produced by the removal of a portion of the abdominal wall, except the skin, it was readily cured several weeks later by the transplantation of fascia flaps.

These experiments suggest the use of fascia flaps in the cure of large herniæ, where the muscle is atrophied, and for strengthening any weakened area in the abdominal or chest wall. The facility with which the fascia unites with the peritoneum suggests its further use in pleural and pericardial defects.

*Group VII.—Transplantation of Free Fascia onto Stomach, Intestine, and Bladder.*

EXPERIMENT 23.—Female, brown and black mongrel, about one year old. *Operation*, January 10, 1911: The bladder was brought up through a midline incision, and a flap of fascia lata was sewed to it with a continuous suture. The bladder was dropped back and the wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

June 27: Animal sacrificed. *Autopsy*.—There were omental adhesions to the fascia. The peritoneum on the surface of the bladder was somewhat puckered under and immediately around the fascia edges. The fascia itself was thickened, but otherwise seemed normal.

*Histology*.—Microscopic examination: normal staining fascia was found. The peritoneal covering of the bladder could not be differentiated.

EXPERIMENT 24.—Female, yellow mongrel, about six months old. *Operation*, January 16, 1911: The stomach was exposed and an incision 3.5 cm. long was made in it, down through the mucosa. The incision was then closed with the Cushing continuous stitch, and over the suture line was placed and sutured a flap of fascia lata. The stomach was dropped back and the wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

January 27: Distemper, animal sacrificed. *Autopsy*.—The fascia was thickened but otherwise seemed normal. It was closely adherent to the stomach wall. There were a few omental adhesions to the fascia, but these could be easily separated.

*Histology*.—Microscopic examination: the sections showed the line of suture. Above this was the layer of fascia which was apparently normal and well nourished.

EXPERIMENT 61.—Male, black and white fox terrier, about one year old. *Operation*, June 5, 1911: A loop of gut was brought up through an abdominal incision and a purse-string suture was placed opposite the mesentery. When the suture was drawn tight and tied the portion within the suture projected outward. The tip of the projection was cut off, exposing the lumen of the bowel. Over this area a flap of fascia lata was sutured snugly and the gut was dropped back. The wound was closed in the usual manner. Dry dressing. *Per primam* healing.

July 3: Animal sacrificed. *Autopsy*.—The omentum was adherent to the fascia, but this was easily separated. The fascia was somewhat thickened, but otherwise seemed normal. It was closely adherent and seemed incorporated with the peritoneum of the bowel. There was a definite puckering of the wall of the gut around and under the fascia. There had been no leakage. From within a small depression in the mucous membrane could be seen corresponding to the pucker made by the purse-string.

*Histology*.—Microscopic examination: the sections showed normal staining, well-nourished fascia. There was marked infiltration of the tissue beneath the fascia with polynuclear leucocytes. There was a great

mass of these cells in the area corresponding to the made defect. On the surface of the fascia was the remains of the adherent omentum..

*Comment.*—This group of free fascia flaps were successfully transplanted onto the stomach, the intestine, and the bladder. The fascia seemed to incorporate itself with the peritoneum (Fig. 10).

Clinically fascia might be used to strengthen suture lines and weakened areas due to ulceration. It might also be of use in closing fistulæ of one sort or another.

*Group VIII.—Transplantation of Free Fascia on Liver, Kidney, and Spleen.*

EXPERIMENT 36.—Female, brindle mongrel, about eighteen months old. *Operation*, February 21, 1911: Through a lumbar incision the left kidney was exposed and after the capsule was stripped back an abrasion of the surface was made and a flap of fascia lata was sutured over it. The hemorrhage ceased promptly. The kidney was dropped back and the wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

March 7: Distemper, animal sacrificed. *Autopsy.*—The skin wound which had apparently healed became infected after the development of the distemper. The fascia was adherent to the surrounding tissues. It was not much thickened and seemed normal. It was tightly adherent to the kidney at the edges, but could be stripped up more easily in the centre of the flap.

*Histology.*—Microscopic examination: the sections showed normal fascia closely adherent to the parenchyma.

EXPERIMENT 52.—Male, black mongrel, about three months old. *Operation*, May 8, 1911: Through a high midline incision a lobe of the liver was exposed. The end of the lobe was cut off with scissors, leaving a bleeding area 3 cm.  $\times$  0.6 cm. Over this surface was placed a flap of fascia lata and the bleeding was markedly checked. The fascia covered the end like a shallow cap, and was held in position by mattress sutures passing through the liver substance and through both sides of the fascia. These sutures were drawn as tight as desired, and did not cut through the liver substance. The liver was dropped back and the wound was closed in the usual manner. Condition on leaving the table excellent. *Per primam* healing.

June 6: Death from pneumonia. *Autopsy.*—There was adhesion of the omentum to the fascia. When this was stripped off the fascia was seen covering the denuded area like a cap. It was slightly thickened but otherwise seemed normal.

*Histology.*—Microscopic examination: the sections showed normal staining, well-nourished fascia surrounding an area of liver substance. It was adherent to a considerable extent.

EXPERIMENT 60.—Black and white fox terrier, about one year old.

*Operation*, June 5, 1911: The spleen was brought up through a left rectus incision, the edge was trimmed with scissors, and a flap of fascia was sutured over the denuded area so as to bind it. The fascia was held with mattress sutures, which passed through the spleen and both edges of the fascia. There was considerable hemorrhage until the fascia was applied and the sutures tied. The spleen was dropped back and the wound was closed in the usual manner. Dry dressing. Condition on leaving the table excellent. *Per primam* healing.

July 3: Animal sacrificed. *Autopsy*.—The fascia was thickened and securely bound the edge of the spleen. It seemed well nourished, and it could be separated from the spleen quite easily.

*Histology*.—Microscopic examination: sections showed normal staining fascia surrounding spleen tissue.

*Comment*.—In this group free flaps of fascia were successfully transplanted on the liver, kidney, and spleen. It suggests that the fascia flaps might be used to support sutures in these organs, and also to bind raw post-operative surfaces (Fig. 11).

It is to be noted that the fascia when applied to a bleeding surface seemed to have a definite hæmostatic effect, which is comparable to the hæmostatic action of bits of muscle, spoken of by Cushing.

The kidney might be suspended to the ribs or muscles in a sling of free fascia. These results are very promising.

REMARKS.—In none of the animals have I noted a muscle hernia after the fascia was removed, but should it occur the hernia could be repaired without difficulty. There is apparently no untoward effect after removal of the fascia lata as far as the use of the limb is concerned.

In every instance the fascia retained its own structure and seemed well nourished. After removal from its bed it was as tough and strong as when first transplanted.

The great strength of the fascia, and, in addition, its thinness and flexibility are to be noted. It can be sutured into a defect under considerable tension, and the sutures will hold securely even when inserted close to the edges or ends of the flap.

The great supply of this material and the ease with which it can be obtained are important points.

There is some difference in the measurements of flaps of





a

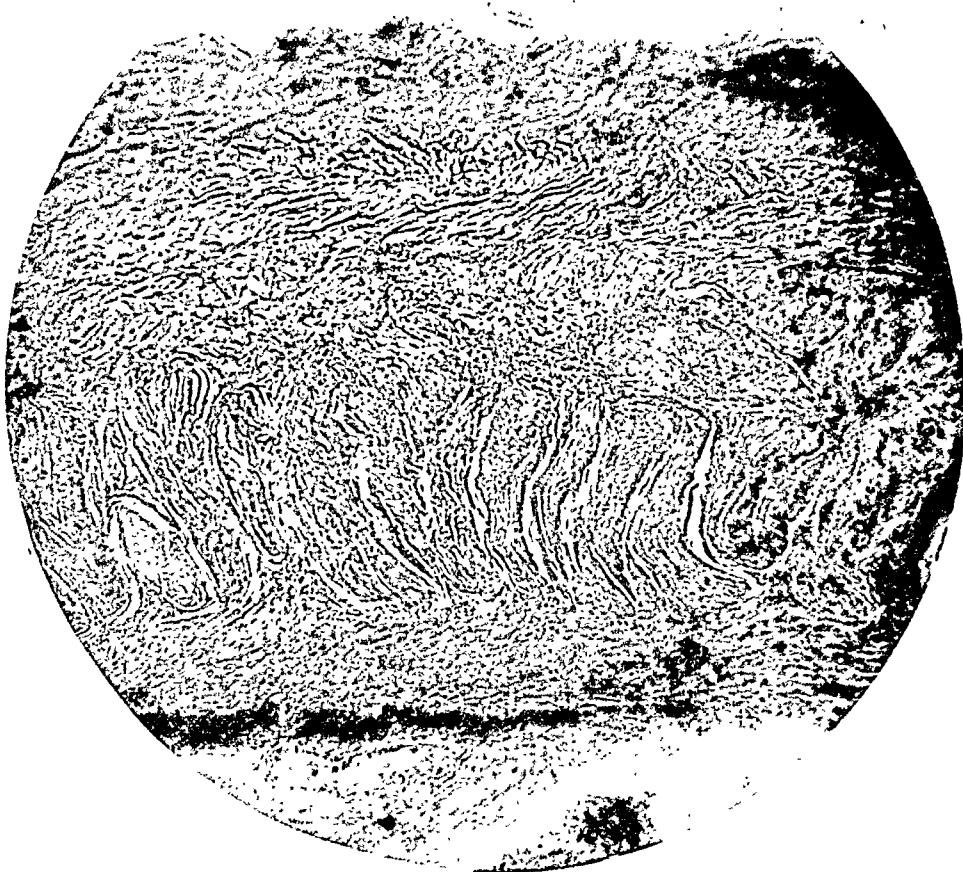


b

Experiment 25.—(a) Fascia on a lobe of the liver. Operation January 17, 1911. Specimen removed January 26, 1911. The fascia was thickened, but was adherent to the liver surface over most of its extent. Experiment 30.—(b) Fascia on kidney cortex. Operation, February 21, 1911. Specimen removed March 7, 1911. The fascia is clearly adherent to the kidney substance and blends with the capsule.

In both of these specimens, as in all the others, the fascia was well nourished.

FIG. 12.



(Microphotograph, Zeiss. Obj. AA. Oc. 3.) Fascia preserved in cold storage wrapped in moist salt gauze for 35 days, and then transplanted on the surface of a trachea. Operation, March 14, 1911. Specimen removed April 10, 1911. The section is cut across the fascia bundles. The fascia is normal in appearance and stains well.

fascia before and after removal. For example, a marked out flap of fascia lata measured  $4.5 \times 2.5$  cm. before removal, and after removal it measured  $3.3 \times 2$  cm. Another flap measured before removal  $4.5 \times 2.2$  cm. and after removal  $4 \times 1.75$  cm.

In several experiments fascia was drawn taut and sutured around firm rubber tubes 0.8 to 1 cm. in diameter, and then inserted in the subcutaneous tissue. These specimens were removed after 49 to 54 days. The structure of the fascia could easily be seen. Microscopic examination showed normal staining fascia with no signs of degeneration.

This is interesting, as it shows that fascia will receive sufficient nourishment if only one surface is exposed to living tissues.

The type of so-called distemper prevalent in the laboratory this winter appeared to have some effect on the healing of the wounds, and a number of them became infected. This did not seem due to a break in technic, as other animals operated on the same morning (before and after these animals), with identical technic, and not developing the distemper, did not break down.

In several animals whose stitches had been removed after *per primam* healing, the skin wound subsequently broke down after the development of distemper.

In the instances where there was infection, the transplanted fascia seemed particularly resistant to it, and retained its structure after breakdown of the surrounding tissues.

Where there was tension on the fascia there was comparatively little thickening, but wherever the fascia was simply laid on a tissue there was always thickening, and unless it was held flat with sutures it had a tendency to bunch or roll up.

Once or twice the fascia flap was accidentally allowed to partially dry out before it was transplanted, but in spite of this it was moistened with salt solution and transplanted. The results were excellent and the fascia was nourished and grew in its new position.

The question naturally arose as to the necessity of transplanting the fascia immediately, and also whether fascia from one animal could be successfully transplanted into another.

Experimentally, both of these questions have been answered satisfactorily (Fig. 12).

Fascia was successfully transplanted into the same and other animals after being kept in an ordinary ice chest,  $38^{\circ}$  for as long as 7 days; in cold storage  $32^{\circ}$  wrapped in gauze moistened with salt solution for 35 days, and in cold storage  $32^{\circ}$  in normal salt solution for 56 days.

I am sure that the number of days given here do not show the greatest time that fascia may be preserved by the methods spoken of, but I mention the periods as a suggestion that suitable fascia might be preserved until needed for clinical use.

Fascia kept in salt solution appeared oedematous when first removed from the solution, but the oedema disappeared when the tissue was pressed with dry gauze. The oedema was entirely in the superficial connective tissue, which had not been removed. The fascia kept in moist salt gauze, on the other hand, was normal in appearance.

When fascia was sutured to the surface of the stomach, intestine, or bladder, within a few days there was the appearance of puckering or drawing up of the surface under the fascia and at its edges, somewhat similar to the effect of ordinary collodion on the skin. On this area, from within the organ, this puckering was not to be found and the lumen was in no way encroached upon.

The hæmostatic action of free fascia flaps is noteworthy.

CONCLUSIONS.—The foregoing experiments give an idea of the great possibilities of transplanting free flaps of fascia, and many suggestions for the clinical use of this substance may be drawn from them.

I feel convinced that many of the difficult situations arising during operations for the repair of weakened and defective tissues or for the control of bleeding surfaces will be simplified by the use of free fascia flaps and shall report the results of its use in such cases with a consideration of the literature in a subsequent paper.

# EXPERIENCES IN THORACIC SURGERY UNDER ANÆSTHESIA BY THE INTRATRACHEAL INSUFFLATION OF AIR AND ETHER.\*

WITH REMARKS ON THE VALUE OF THE METHOD FOR  
GENERAL ANÆSTHESIA.

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ABOUT two years ago, Meltzer and Auer first described the method of artificial respiration by the intratracheal insufflation of air. In later publications they showed that in animals the method was of great value for experimental investigations in which one or both pleural cavities had to be opened. They described a very simple method by which the animals could be anæsthetized by intratracheal insufflation of air and ether, and expressed their belief that the method would be of great value for thoracic surgery in the human being. Soon afterward, Carrel made use of the method for his operations upon the heart and aorta of dogs, and recommended it for intrathoracic experimental work. At the same time, the writer had been making a large number of investigations on dogs, and with the aid of Dr. Neuhof had performed a not inconsiderable number of operations upon the lungs, the bronchi, and the œsophagus in these animals. Thus we removed one or several lobes of one or both lungs, made incisions into bronchi, with subsequent suture, etc. In all of these operations the method of intratracheal insufflation worked admirably. One or both pleural cavities could be widely opened, and all the necessary intrathoracic manipulations performed and the animals remain in good condition throughout the operations. After the thoracic wall had been closed by suture and the intratracheal insufflation stopped and the intratracheal tube removed, the animals began to breathe again in a perfectly

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\*Read before the Philadelphia Academy of Surgery, May 3, 1911.

normal manner. Unless death occurred from sepsis or followed from an unsuccessful operative procedure, the animals recovered entirely. When the dogs were killed days, weeks, or months after the operations, the larynx, trachea, and lungs were found in perfectly normal condition.

As has been described in previous papers, the insufflation was carried on by means of a very simple apparatus which had been devised by Meltzer and Auer, and no care was taken to filter, warm, or moisten the air which was blown into the trachea. Nevertheless no lesion could be found post mortem in the respiratory tract of these dogs. The anæsthesia was a very good one and seemed to be absolutely devoid of danger. It is well known that it is easy to kill a dog by means of ether given by inhalation, but we have found it impossible to kill the animals with ether given by intratracheal insufflation. This safety is probably due to the fact that so much of the ether escapes upward in the trachea and out through the larynx and mouth.

In previous papers, I have described a simple and portable apparatus for intratracheal insufflation anæsthesia in man. In what follows I shall give an account of our experiences with the method for general anæsthesia and shall report upon the cases of intrathoracic surgery which we have had up to the present time.

*The Value of Insufflation Anæsthesia for General Surgery.*—We have, at Mt. Sinai Hospital, New York, anæsthetized about 200 patients by means of intratracheal insufflation, and have found the method very valuable for a great many operations. In all but a few cases, the anæsthesia was a very satisfactory one, particularly free from complications and after effects. It is very easy to keep the patients under full anæsthesia, vomiting has never occurred during the anæsthesia, and the patients were never too deeply under the ether. At the conclusion of the operations, the patients awakened very rapidly, especially if pure air was insufflated for a few minutes before the intratracheal catheter was withdrawn. Vomiting after the operation was very unusual no matter what the surgical procedure that had been performed, and the pa-

tients never complained of pain or discomfort in their laryngeal regions. We have thus far not seen any pulmonary complications after insufflation anæsthesia.

In one patient, we failed to obtain complete muscular relaxation so that the necessary intra-abdominal manipulations could be accomplished.

In the case of a young girl, who was to be operated upon for chronic appendicitis, it was found impossible to cause complete relaxation of the abdominal walls. We finally attempted to obtain complete anæsthesia by means of ether given by inhalation, but the patient still struggled. Only when chloroform was given by inhalation was perfect relaxation obtained.

This patient was evidently one who was refractory to ether. It is possible that the intratracheal tube that we used was too small, so that too much of the air and ether mixture escaped by the side of the tube.

Operations under insufflation anæsthesia were performed upon patients suffering from a variety of acute and chronic surgical diseases. Our experience up to the present time will allow us to mention the following operations in which we have found the anæsthesia of especial value. In operations upon the neck and more especially those around the trachea such as thyroidectomy, the method is very useful. Not only is the anæsthetizer never near the field of operation, but the operator can work around the trachea without causing any interference with the breathing. There is no danger of sudden collapse of the trachea when a large goitre has been removed, and no matter how much the trachea is handled, the anæsthesia continues smoothly and evenly. Intratracheal anæsthesia should be very advantageous for the operation of laryngectomy. The intratracheal tube could either be introduced through a tracheotomy wound and the trachea packed with gauze above this point, or the tube could be passed through the glottis in the usual manner, and removed only at the moment when the trachea is to be divided across after the entire larynx is free.

We have found that operations upon the face and jaws and mouth, where the buccal cavity or pharynx has to be in-

vaded, are made more easy and safe when done under insufflation anæsthesia. No blood or secretions can run down the trachea, for the out-flowing current passing upward in the trachea blows out any fluid that might run down into the larynx.

In operations upon the brain and spinal cord where the patient must often be placed in the prone position, the anæsthesia is very useful. As soon as the intratracheal tube has been introduced and the insufflation has been begun, the patient's head and body can be placed in any position desired and the anæsthesia given from a distance. The anæsthetizer need not be seated underneath the table as is ordinarily necessary.

*Experiences with Insufflation Anæsthesia in Thoracic Surgery.*—Insufflation anæsthesia is a positive pressure method and was primarily suggested for intrathoracic surgery. On account of the simplicity and apparent safety of the method it may take the place of all the more complicated positive and negative pressure cabinets. The operations upon animals gave such very satisfactory results, that we were very hopeful that the method would give as good results in thoracic operations in the human being. We were very careful in our first human operations, but, with increasing experience, have gained more and more confidence in the efficiency of insufflation in man. In the following are recorded the experiences we have had up to the present time:

CASE I (Reported in the ANNALS OF SURGERY, July, 1910).—*Abscess of the lung; thoracotomy and aspiration of the lung under intratracheal insufflation. Recovery.*

B. F., a butcher, fifty-five years of age, was referred to the II Surgical Service by Dr. Manges with the diagnosis of an abscess of the middle lobe of the right lung.

February 14: The patient was anæsthetized with ether, and the attempt was made to introduce a small catheter into the trachea. The patient took the ether very badly, and I did not have on hand the proper kind of a tube nor the necessary instruments for the intubation. After a number of unsuccessful attempts to pass a catheter through the larynx we determined to put off the intubation until a later time. The operator (Dr. Lilienthal) then resected four inches of the eighth and ninth ribs and packed the wound cavity with gauze.

February 20: Operation by Dr. Lilienthal, intratracheal insufflation



by Dr. Elsberg. Ether anæsthesia; larynx and pharynx thoroughly anæsthetized with cocaine. A soft rubber tube, No. 28 French scale, was passed through the glottis by means of a laryngeal forceps and pushed downward until a slight resistance was encountered. The tube was then fixed to the upper teeth by means of a gag. The tube was connected with the insufflation apparatus and a mixture of air and ether blown in under a pressure of 15 mm. of mercury. The patient began to cough violently, therefore the intratracheal tube was withdrawn about one inch. The coughing ceased at once, and at the same time all evidences of mucus in the trachea or pharynx disappeared. The patient's color was good, respirations regular, pulse of good quality. The patient was now turned on the left side and the operation begun.

3.10—No cyanosis, pulse 120; incision 12 cm. in length into right pleural cavity; pulse unchanged, color good, no cough. Pressure of current now raised to 20 mm. Palpation of the lobes of the right lung.

3.20—Pulse 108; respirations 48; color good with slight cyanosis; pleural cavity is wide open.

3.25—Heart action excellent; pulse 96; color good, no cyanosis; aspiration of middle lobe of lung.

3.30—Pulse 105; respirations 42; color good.

3.35—Pulse 108; respirations regular, 40. The current of air is interrupted several times in order to observe the appearance of the lung. When the current is prevented from entering the intratracheal tube the lung collapses and is of a dark green mottled color; when the lung is markedly distended (25 mm. pressure) the lung is of a bluish color with areas of red. When the lung is collapsed the œsophagus and aorta can be seen and examined.

3.40—Suture of incision in pleura. While the last stitches are being passed the pressure is raised to 30 millimetres in order to slightly overdistend the lung so that as little air as possible shall remain in the pleural cavity.

3.45—Pleura closed with small drain; pulse 132 and of good quality.

3.50—Color good, no cyanosis; respirations 32.

3.55—Suture of muscles and skin; voluminous dressing. The intratracheal tube is withdrawn. Pulse now 120, of good quality; respirations regular, no cyanosis.

Four minutes after the patient was taken to his bed he was awake. He said that he did not have any pain in his larynx; he was not hoarse. The morning after the operation the patient was in very good condition. He complained of some pain in the right chest and had considerable mucopurulent expectoration. He was not hoarse and did not complain of any pain in his laryngeal region. The auscultation of the right side of the chest through the bandages was not satisfactory, but breathing sounds could be heard over the entire side.

From this time on the patient steadily improved, the cough and expectoration grew less daily; he was out of bed on March 10 and was discharged from the hospital with his wound almost healed on March 25. When last seen (April 22) he was in excellent condition; the breathing sounds over the right side of the chest seemed normal; he

had almost no cough and practically no expectoration; he had gained considerable flesh and strength.

The patient returned to the hospital about six months later on account of a large pulmonary hemorrhage. He had another large hemorrhage from the lungs soon after his admission, to which he succumbed. No autopsy could be done.

CASE II.—John H., fifty-two years of age, admitted to Mt. Sinai Hospital on January 2, 1911, with the history of increasing difficulty in swallowing for ten months. He had lost 40 pounds in weight and was able to swallow only small quantities of fluids. The stomach tube was arrested 12 cm. from the teeth, and an X-ray picture taken after the ingestion of bismuth showed a marked narrowing of the œsophagus at this point.

On January 7 the patient was anæsthetized with ether in the usual manner, a catheter No. 24 French introduced into the trachea, and intratracheal insufflation begun. The patient was turned on the right side, and an incision was made in the seventh intercostal space from the costal cartilage in front to the angle of the ribs behind (Dr. Elsberg). The incision was deepened through the muscles until the pleura was exposed. The lungs were now momentarily collapsed while the incision in the pleura was made. The ribs were now drawn apart by means of the rib spreader and the left pleural cavity widely exposed. The lungs were of a mottled pink color and moderately distended (pressure 30 mm.). Pulse slow and of good quality; very superficial respiratory movements. The lung was now carefully drawn toward the median line and the pericardium exposed; this was also drawn to the right so that the root of the lung was visible as well as the aorta and the œsophagus with the left vagus nerve.

About five inches above the diaphragm there was a hard nodular tumor of the œsophagus of the size of a large plum. There were no enlarged glands at the root of the lung. The tumor was free on all sides excepting where it lay against the aorta. The attempt was made to free it from its attachments to the aorta, but this was found impossible without great danger to the wall of the vessel. The tumor was, therefore, considered inoperable.

The incision in the pleura was closed by a fine running catgut suture, with interrupted sutures of strong catgut around the adjoining ribs. When the last stitches in the pleura were being

passed, the anæsthetizer was instructed to raise the pressure to 50 mm. of mercury, so as to distend the lung and expel as much air as possible from the pleural cavity. Then followed suture of the intercostal and pectoral muscles and skin in the usual manner. Large vaseline gauze dressing.

During the entire operation, which had lasted 57 minutes, the patient was in good condition; color of face pink, breathing superficial, pulse of good quality. Insufflation of pure air for three minutes at end of operation; then removal of intratracheal catheter.

Five minutes later the patient was awake and responded to questions. Four hours after the operation the respirations were 24 to the minute, and upon auscultation through the dressings, breathing sounds could be heard all over the left chest.

Convalescence thereafter was smooth and uncomplicated; the patient never had any respiratory difficulty; his pulse and respirations were practically normal; he was sitting up in bed on the third day after the operation.

On the evening of the sixth day after the operation, his temperature suddenly rose to  $102^{\circ}$ , and he suddenly complained of severe pain in the left chest, his pulse became very rapid and feeble. In spite of active stimulation he soon went into a condition of collapse and died a few hours later.

The post-mortem examination showed that there had occurred an infection of the pleural cavity by direct extension from the ulcerated carcinoma of the œsophagus.

Marked cyanosis during the preliminary ether anæsthesia by inhalation. Color became good as soon as the insufflation anæsthesia was begun; pulse good during the entire operation. Thoracotomy; incision of the lung; drainage of an abscess cavity in the middle lobe of the right lung (Dr. E.). Uncomplicated convalescence with persistence of bronchial fistula. Death after several months from a metastatic abscess of the brain.

CASE IV.—Female. *Bronchiectatic abscess of the right lower lobe.* Thoracotomy and exploration of the lung (Dr. E.) under insufflation anæsthesia (pressure 25 to 35 mm.). Condition of patient good during entire operation. The abscess cavity had emptied itself before the operation and could not be found.

CASE V.—Female. *Metastatic abscess of the lung after an infarct following another operation.* Intratracheal insufflation, thoracotomy and drainage of abscesses in left upper and lower lobes (Dr. E.). Condition of patient during operation good. Breathing movements ceased as soon as pressure is raised to 40 mm. of mercury. Recovery from the operation rapid and uncomplicated, but fever persisted. Patient died about six weeks after the operation. The autopsy showed that there were numerous abscesses that had not been drained.

CASE VI.—Female. *Interlobar empyema.* Thoracotomy and drainage under insufflation anæsthesia (Dr. Gerster<sup>1</sup>). Recovery.

CASE VII.—Female. *Gangrene of the lung.* Intratracheal insufflation anæsthesia. Marked cyanosis during preliminary anæsthesia; insufflation of air, oxygen, and ether. Color pink after insufflation was begun. Thoracotomy and drainage of gangrenous areas in right lung (Dr. Gerster<sup>1</sup>). Insufflation anæsthesia very satisfactory; satisfactory recovery from the operation itself. Death about one week after the operation from exhaustion from the sepsis.

CASE VIII.—Male. *Interlobar empyema.* Intratracheal insufflation. Thoracotomy and drainage (Dr. E.). Insufflation anæsthesia very efficient; lungs could be distended and collapsed at will. General condition of patient remained good during the entire operation. Uncomplicated recovery.

CASE IX.—Female, operated upon in Worcester, Mass. *Recurrent carcinoma of chest-wall* after extirpation of breast for carcinoma seven years before. Insufflation anæsthesia; catheter

<sup>1</sup> I am indebted to Dr. A. G. Gerster for permission to include his two cases.

the glands of Brunner, situated in the duodenum, while its external secretion is even more closely associated with that of the bile.

*Anatomy.*—The protected position of the pancreas emphasizes its importance. The head lies closely embraced by the duodenum just beneath the pylorus, its body behind the stomach covering the great vessels, while its tail reaches over to the spleen and left kidney. The embryologic development of the pancreas, as two separate outgrowths from the primary foregut to afterward coalesce, is important to keep in mind, as it often retains two separate ducts, Wirsung and Santorini. The latter is the direct duct, yet in 20 per cent. of cases it undergoes complete obliteration, while in the remaining 80 per cent. it anastomoses with the indirect or duct of Wirsung, and empties by a separate orifice into the duodenum. In one individual out of ten the duct of Santorini is even of larger calibre than the duct of Wirsung. In such cases as this, the pancreatic secretion will be emptied into the duodenum even when the Wirsung duct is occluded.

The common bile-duct in conjunction with the duct of Wirsung enters the under surface of the second portion of the duodenum through a vestibule, the ampulla of Vater, where the secretions from the two glands are mixed before they take their respective places ~~in the~~ digestive process.

The anatomic relation of the main duct of the pancreas and that of the liver has its physiologic significance in showing the importance of associating bile in the process of digestion. From a pathologic standpoint, this association is most unfortunate, for it is the factor in causing many of the morbid processes to which both the pancreas and biliary passages are subject. In two-thirds of all cases the bile-duct passes directly through the head of the pancreas on its way to the duodenum. This fact, together with the close vascular and lymphatic association between the bile passages and pancreas, furnishes the pathogenesis of the greater number of the cases of pancreatitis. It is obvious that infection of one of these organs must be easily transmitted to the other, though this, of course, does not ex-

clude such constitutional dyscrasias as mumps, typhoid fever, phthisis, syphilis, and arteriosclerosis having a large responsibility in bile-duct and pancreatic disease. Pressure of the swollen head of the pancreas on the common bile-duct is a causative factor in epidemic jaundice, second only in frequency to cholelithiasis and duodenitis, though mumps, according to collective investigation of Egdel, is responsible for 10 per cent. of all cases of pancreatitis.

Of greatest interest is the association of cholelithiasis with chronic interstitial pancreatitis, the so-called interlobular form. This is due to duct obstruction from gall-stones, with infection always present, though fortunately usually mild. The interacinar form of pancreatitis is less commonly met with and differs from the rough and nodular interlobular variety in being smooth and tough with glycosuria usually present in the latter on account of involvement of the islands of Langerhans, though in the interlobular variety these areas may also become involved, causing secondary diabetes. It is generally admitted that chronic interstitial pancreatitis may exist for years without appreciable change from the original disease, though during this period the proteolytic, the lipolytic, and diastatic properties of both its external and internal secretions will be noted in the characteristic findings in the intestinal excreta and the defect in its metabolic function of converting both sugars and fats.

This chronic process will not only cause disease of contiguous organs or viscera, but will, and generally does, extend to remote ones through faulty metabolism.

*Symptoms.*—Symptoms that arise from pressure on the common bile-duct, due to the swollen head of the pancreas, cannot be differentiated with accuracy from those due to cholelithiasis. Both conditions cause jaundice, though that caused by pancreatitis is more apt to be permanent, with associated cutaneous pigmentation and a rapid effect on the constitution evidenced by a profound and progressive emaciation, the result of pancreatic insufficiency (*achylia pancreatica*). While in bile-duct obstruction uncomplicated by pancreatic disease,

pain and jaundice exist during the acute attack of colic only or during the temporary passage of calculus through the common bile-duct and when cholelithiasis and pancreatitis co-exist, there is a distinct point of tenderness upon pressure, half way between the ninth rib and the umbilicus, and a second area of tenderness over the right rectus abdominis muscle, above and to the right of the umbilicus.

If duodenal ulcer can be excluded, these symptoms would justify diagnosis of pancreatitis. Reflex pain radiating to the midscapular or left scapular region, together with absence of emaciation and the presence of hyperchlorhydria and pain when the stomach is empty, will exclude duodenal ulcer. In pancreatitis it is generally possible to detect an enlarged, hardened, and tender pancreas, extending across the upper abdomen, and a careful study of the alimentary excreta will reveal large light-colored, grassy stools, which are not found in duodenal ulcer. But most important is the discovery of nucleated muscular fibres in the stools, as the presence of these is distinctly a feature of pancreatic insufficiency, and occurs in pancreatitis only; as a further laboratory effort toward establishing a diagnosis the urine should be examined for Camidge crystals. Emaciation is at times so rapid as to suggest malignancy.

**ACUTE PANCREATITIS.**—The pancreas has been aptly described as the salivary gland of the abdomen, and, were it not for its association with the main duct of the liver, it would probably seldom be the seat of acute inflammation, the symptoms of which are sudden onset of agonizing pain, deep-seated and referred to the right of the epigastrium and followed by great prostration, rapid pulse, early elevation of temperature, nausea, vomiting and early tympanites accompanied by (according to Opie, Ochsner, and Halstead) marked cyanosis, especially about the face and abdominal walls. With this group of symptoms, as they are the most classic, it is difficult to make a diagnosis, because the upper abdominal muscles are extremely tense and the abdomen generally tympanitic, so that this group of symptoms does not differ materially from those arising from

such acute conditions as intestinal obstruction, perforation of the hollow viscera, renal colic, or ectopic gestation.

Sugar may be present in the urine, in some cases, where chronic pancreatitis has existed for a considerable period, free fat (according to Fitz) may be seen in the fæces upon inspection, and occasionally a tender, tumorous mass can be felt. It is fortunately a condition where accuracy of diagnosis is not essential, since the simulating conditions all require surgical intervention.

The patient is usually at or about middle life, fleshy, and with an alcoholic history, and he rapidly develops a bronzed appearance (hæmatogenous jaundice). This pigmentation is characterized by uniformity and absence of mucous membrane discoloration. From the onset of the attack these patients are in a state of collapse, and therefore not promising subjects for operative treatment, yet immediate operation offers the only possibility of cure. Robson, by this means, had 23 recoveries out of 59 operated.

The operative procedure consists in a median abdominal incision above the umbilicus, which will disclose an excessive amount of blood-stained peritoneal fluid, usually stones in the gall-bladder and common duct, while the pancreas will show hemorrhagic infiltration and numerous areas of fat necrosis, recognizable as yellow spots, while the swollen organ itself will give on palpation a semi-fluctuating feel.

The treatment, which is surgical from the onset because of the profound toxæmia that actually ushers in the attack, should consist of promptly establishing free drainage through incisions made in several parts of the gland. If excessive hemorrhage ensues, it can be controlled by gauze packing held in place by sutures. The final step must be to establish free drainage through the abdominal incision anteriorly by means of either perforated rubber or glass tubes thoroughly protected by gauze pack. Posterior drainage, which is advocated by some, cannot be so effectual as the anterior route, because the head of the pancreas, which is the seat of greatest infection, lies in front of the vertebræ and is therefore not directly accessible from that point.



If stones are present in the gall-bladder or bile-ducts, or there is acute infection of the bile-ducts with jaundice, it is necessary in addition to free the gall-bladder and ducts of accumulated calculi, and establish drainage by a right lateral incision through the anterior abdominal wall, provided the patient's condition will permit.

**SUBACUTE PANCREATITIS.**—There is a certain number of acute cases where, because of either a lessened amount of virulency or an impairment in the activity of the infective products, the severity of the symptoms as noted in the acute form of the disease are less marked, and a more favorable outlook from the onset is to be expected. The patient has passed through the height of infection, and thereby built up a resistance that offers to surgery a better prognosis.

When the abdomen of such a case is opened, there are found scattered through the omentum, mesentery, and fatty tissues areas of fat necrosis, which have resulted from the escape of the fat-splitting ferments of the pancreas with here and there multiple foci of purulent material.

*Treatment.*—Treatment consists in evacuating the abscesses and draining. Calculi in the gall-bladder and the bile-ducts should be removed and free drainage instituted. Search must also be made for hæmatoma, which may be found either in the pancreas or adjacent tissues, the result of pancreatic apoplexy.

**CHRONIC PANCREATITIS.**—Chronic interstitial pancreatitis is usually characterized by an antecedent history of indigestion with mild gall-stone attacks. The fact that two-thirds of all common bile-ducts pass through the head of the pancreas is sufficient to emphasize the certainty that, in at least two-thirds of the cases of chronic pancreatitis, drainage through this duct must be interfered with, making jaundice a conspicuous objective symptom, though in a certain number of cases this symptom may be absent and yet the common bile-duct may be distended. This fact shows that dilatation of the common duct may exist independent of gall-stones, and both the duct and the gall-bladder may be distended without jaundice.

Courvoiser estimates that because of gall-stone irritation

84 per cent. of the cases of common duct stones have atrophied gall-bladder. Therefore, the size of the gall-bladder in chronic interstitial pancreatitis depends upon whether gall-stones are or have been present.

Pancreatitis may cause such marked distention of the gall-bladder and primary jaundice without calculi being present that malignancy may be suggested. When, however, the latter is the cause of the obstruction, the glands in the fissure of the liver become early involved, and the pressure arising therefrom so interferes with portal circulation that ascites early develops.

The intestinal excretion is large in quantity and greasy. Microscopically examined it will show nucleated muscle fibers and fat. If jaundice is absent the stools will be a bright yellow color, due to an absence of the pancreatic juices. These patients abhor meats and fats.

*Treatment.*—The treatment of chronic interstitial pancreatitis is equally surgical from the onset, though, because of a milder degree of infection, radical treatment can, in some instances, be delayed to give medical treatment a chance. The latter, however, should not be persevered in until it has been proven useless, for if thus delayed, surgery may not be given its full opportunity.

The underlying principle of the surgical treatment is to establish either temporary or permanent isolation of the pancreatic and bile-ducts, so that infection from either can as nearly as possible be removed from the other. In undertaking to clear the ducts of the partly obstructing calculi, it is important for us to bear in mind that some of them may be concealed under the enlarged head of the pancreas, or small ones may be lodged in the hepatic ducts, above the primary division. This can always be avoided by careful palpation. After the removal of all stones and the freeing of the bile-ducts and pancreas from adhesions, a large flexible probe should be passed through the common duct into the duodenum. This, together with external gall-bladder drainage, will usually not only establish but maintain free drainage and prevent recurrence of infection.

Cholecystostomy, in my experience, is sufficient to cure the majority of these subjects, and is therefore the procedure of election, as it enables one to remove calculi and establish temporary external drainage more satisfactorily than any other operative procedure that I have generally employed. In cases, however, where it is essential to promptly supply the bile to the intestines for aiding digestion, cholecystenterostomy is the operation of choice. If there is total obstruction of the common duct from pressure of the head of the pancreas, then cholecystduodenostomy or cholecystojejunostomy will be required to overcome the obstruction.

The surgical treatment of chronic interstitial pancreatitis, unless calculi are present, is directed toward the biliary tract rather than the pancreas, and is best accomplished by diverting the bile to the surface or to a new place in the gastro-intestinal canal, by some of the several operative procedures now so generally employed. Cholecystostomy is indicated in by far the greatest number of cases. The methods of employing the stomach and the hepatic flexure of the colon for the purpose of diverting the bile have not, as yet, taken precedence over those above referred to, and which are more generally employed.

# GASTRIC AND DUODENAL ULCER.\*

A RECORD OF 110 RECENT OPERATIONS.

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SINCE my first deliberate operation for the relief of symptoms due to chronic gastric ulcer, in March, 1900, a very large number of these cases have come under my care. It may, I think, prove interesting and instructive if I very briefly place on record some lessons to be learned from a study of the cases. In doing so, I do not propose to waste time by any recapitulation of well-established facts, but to see how far we can throw any fresh light on what is one of the very commonest ailments which we are called upon to treat.

For the purposes of this paper, I have collected all my cases since September, 1908. The list shows 110 cases, with three deaths, all of which occurred in my private practice—one from pneumonia, one from plastic peritonitis, one from wound infection caused by the patient herself.

This represents a mortality of 2.7 per cent. With great care in the selection of cases and improved technic, I have no doubt still better results can be obtained.

My cases were in no way selected. Several of them were so wasted and feeble that it seemed very doubtful whether they could stand a general anæsthetic. No case was refused except on the ground that a thoroughly efficient course of medical treatment had not been submitted to. In several instances the operation was a very complicated and difficult one.

Two patients were over sixty years of age.

When we consider the debilitated and unhealthy condition

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\*Read before the Ulster Medical Society, March 2, 1911.

tion of a large number of sufferers from long-standing gastric ulcer, I am afraid we must always be prepared to face an appreciable risk. It is never right to underestimate the gravity of any operation, but I am satisfied that we may quite safely put the risk in an average case as not higher than 2 per cent.

There can be no doubt whatever that this is decidedly less than the ordinary medical risk. The risk of perforation alone cannot possibly be put below 5 per cent., and is probably much higher. The risk of hemorrhage is difficult to estimate, there being no reliable statistics, but experience teaches every medical man that this is not an uncommon cause of death.

During the past three years I have known one patient die from hemorrhage, and two from perforation, while considering the question of operation. Several of the cases operated on by me were on the verge of perforation, all the coats of the stomach having been eaten away except the peritoneum, which fortunately was strengthened by adherent omentum or plastic lymph, nature having done all in her power to avert a calamity.

The medical risk is, however, a somewhat vague and indefinite one which may never materialize; and which it is fair to point out, may not terminate fatally if promptly and skilfully treated.

The operation risk is one which is deliberately faced, and this requires some degree of courage on the part of the medical attendant who recommends it, and still more in the patient who submits to it.

In this connection I would like to point out the exceptional mortality attending perforation occurring in the victim of a dilated stomach.

In January, 1911, a railway porter consulted me. He had a greatly dilated stomach, and was very weak and exhausted. He went into hospital on a Saturday afternoon with a view to operation on the following Tuesday. At 11 o'clock on Saturday night he suddenly perforated. In my absence from town Mr. Fullerton very kindly operated on him within three hours after perforation. He never rallied,

however, from the initial shock, and died on Sunday forenoon.

In 1900 I saw with Dr. Calwell in the hospital a man with a greatly dilated stomach. We both strongly urged an operation, which was declined. He went to the convalescent home where he perforated and died in a few hours.

These cases are very liable to perforate, and when this accident happens, the peritoneum is simply drenched with stomach contents, often in an advanced condition of decomposition. The result is a profound toxæmia, almost certain to terminate fatally.

The study of a series of cases such as I now submit, in which the condition of the stomach has been actually inspected during life, should, I think, help us to appreciate, at their proper value, the individual signs and symptoms on which we are accustomed to rely for a diagnosis of gastric or duodenal ulcer.

These symptoms—pain, vomiting, hemorrhage, local tenderness, and local hyperæsthesia—and the evidence furnished by examination of the stomach contents, I now propose to consider very briefly.

*Pain* is the only symptom common to all cases, and though an ulcer may be present either in the stomach or duodenum, and may even perforate all coats of the organ before the onset of pain, I am satisfied that no physician would feel justified in coming to a diagnosis of ulcer in the absence of this cardinal symptom.

To be of any real value, the pain must have a definite relation to food. The patient must be quite clear as to the effect of a meal, and of different kinds of food.

Pain coming on at night is of the greatest importance, especially when it wakens the sufferer at a definite hour. This does not occur in the purely neurasthenic type.

I have never failed to find a well-defined ulcer where typical night pain was complained of.

Pain which radiates into the back is also of special value, and in my experience has generally been associated with an ulcer on the lesser curvature or on the posterior surface of

the stomach. I cannot, however, dogmatize on this point. It is merely the impression that has been left on my own mind.

I have operated on several cases of long standing, two of them with hour-glass stomach, in which the constriction would scarcely admit a single finger, who stoutly maintained they had never vomited. Pain was their one and only symptom, and as years went by it became steadily worse. "Hunger pain," a gnawing, aching, or burning pain, coming on two or three hours after food, relieved by taking more food, soda, or even a warm drink, is, when typical in its manifestation, especially if it come on at night, almost pathognomonic of duodenal ulcer.

The following case, however, shows that we must exercise caution ere expressing a dogmatic opinion:

A young married lady, aged twenty-nine, visited me on February 28, 1910, accompanied by her husband. She informed me she had come to arrange for an operation for duodenal ulcer. She had seen several medical men, had tried milk diet, and rest in bed, without benefit.

Her daily history, with slight variations, was as follows: Quite comfortable when she got up in the morning; breakfast 9 o'clock, pain coming on about 11.30 to 12 o'clock, and getting worse till dinner at 1 o'clock. This meal at once gave relief, and she was quite comfortable till between 3 o'clock P. M. and 5 o'clock P. M., the interval depending on the nature of her dinner. Once the pain began it steadily got worse, so that if she happened to be down town shopping she was obliged to have afternoon tea, the result of which was prompt relief. She took her ordinary tea about 6.30, after which she generally remained well, but occasionally the pain came back about 8 o'clock. It, however, never came on after she went to bed nor wakened her at night. She had slight tenderness over the right rectus at the level of the umbilicus. This being below the usual site, I inquired whether she ever had an attack of appendicitis, but she could recollect nothing of the kind. At operation. March 6, 1910, her stomach and duodenum. The appendix was  $4\frac{1}{2}$  inches long. At a point 1 inch from the cæcum it was tightly constricted, the remaining  $3\frac{1}{2}$  inches was distended to the thickness of an

index-finger, and the tip was fixed by adhesions. The appendix was removed. She made a rapid recovery, and her medical attendant informs me she has remained well since the operation.

This history at first sight appeared quite typical. The absence of night pain, and the position of such tenderness as appeared to be present, suggested the possibility of an appendical origin. Our incision was therefore made through the right rectus opposite the umbilicus, so that it could be extended up or down as required.

Another condition which sometimes gives rise to a false "hunger pain" is that arising from a number of smooth gall-stones in the gall-bladder. Two or three hours after a meal, when the stomach contents begin to pour freely into the duodenum, the gall-bladder contracts in order to meet the extra demand for bile; and in the presence of calculi this contraction may be associated with a dull gnawing pain. Other symptoms, however, on careful analysis generally suffice to differentiate between the pathological lesions.

Fortunately an error in diagnosis is of little importance in view of the treatment. Either condition calls for surgical interference, and the same incision, *i.e.*, a vertical one, through the right rectus exposes both gall-bladder and duodenum. I have twice had to remove gall-stones after completing a gastrojejunostomy. One of these was in the present series.

Now we come to the question of *local tenderness*. When present, tenderness on deep pressure is a sign the value of which cannot be overestimated. Unfortunately I have only found it in about 10 per cent. of my cases, and a careful investigation on this point has been made by me for some years. When typical, it has invariably been associated with some localized acute peritonitis around the ulcer.

An ordinary chronic indurated ulcer is *not* tender on pressure any more than a chronic appendix exhibits tenderness. Just as the onset of an acute manifestation in an old quiescent appendix is heralded by local tenderness and rigidity, due to peritoneal involvement, so too does epigastric tenderness and



rigidity indicate clearly and decisively that there is danger ahead. The ulcer is threatening to perforate; inflammatory reaction is taking place to seal and secure the danger zone.

In every instance in which this symptom was well defined the presence of recent peritonitis with inflammatory lymph was easily demonstrated to every one present at the operation.

If this lymph becomes organized into a firm adhesion the tenderness gradually disappears.

I wish to lay it down as a trustworthy clinical rule that tenderness is a danger signal, and that severe or persistent tenderness is one of nature's calls for help, and if neglected, the next and unmistakable call may be the tragedy of perforation.

*Local hyperæsthesia*, to which considerable weight is attached by some writers, was only present in about 3 per cent. of the cases examined by me. If present, both at the anterior and posterior terminations of the same spinal nerve, it is a very valuable sign, as it serves at once to eliminate neurasthenia. It is almost inconceivable that any one without a minute knowledge of anatomy could accurately locate tenderness along a single nerve in the absence of a pathological cause.

*Hemorrhage* has been distinctly noted at some period of the illness in 40 of my 110 cases. Allowing for the possibility that it may have been overlooked in some instances, I think it may fairly be estimated to occur in 40 per cent. I of course, only refer to visible blood. The regular examination of the fæces for microscopic traces of hemorrhage is never likely to be anything but an exceptional procedure, and is therefore of little practical value to the general practitioner.

In all my private and most of my hospital cases, a routine examination of the stomach contents has been made. Except in cases of dilatation, and to enable me to exclude malignancy by ascertaining the presence or absence of free HCl, I am bound to say that the information obtained has not been so helpful, from a practical stand-point, as I had at first anticipated.

Before deciding on such a serious step as operation, I think the stomach tube should be called to our aid in all but exceptional circumstances, and a chemical test should be made, so that nothing known to science may be overlooked.

Coming to the important question of treatment, I wish to lay down the rule that, in my view, gastric ulcer is essentially a medical disease. A very large number of these cases are curable by medical means. It is only when the complications arise, when relapses are frequent, or when the disease has become chronic that surgery has any vocation in non-malignant disease of the stomach. On the other hand I know of nothing more striking than the promptness and thoroughness of the relief which follows a well-planned operation on a stomach which is the seat of a chronic ulcer or its sequel.

Before discussing this question I would like to raise a point as to medical treatment. Is the stomach washed out as often as it should be? If properly used the stomach tube is not nearly so difficult to swallow or so uncomfortable as might at first sight appear. The application of a solution of cocaine to the soft palate and epiglottis, the assurance that there is no danger, and above all the carrying out of the instruction to breathe through the nose, will enable a patient to go through this ordeal even for the first time with very trifling discomfort.

To wash out the stomach each night, thoroughly empty it of acid contents, and minimize the effects of gastric stasis, which is present in a greater or less degree in all of these cases, is, I believe, good treatment. Contrary to popular opinion I do not consider hemorrhage a contraindication to this practice; I have frequently used it in cases subject to hæmatemesis, and have seen no ill effect.

*Hæmatemesis* is still best treated by medical measures. Of these I do not hesitate to say that in my experience the subcutaneous injection of normal horse serum has been incomparably superior to all others; 20 cc. of the serum may be given with an ordinary antitoxin syringe at the outset, and repeated night and morning, or oftener if desired. This need

not supplant other well-known medical remedies, but should never be omitted when the bleeding is at all dangerous.

Administration of ice so constantly resorted to seems to do more harm than good. Small quantities of adrenalin at frequent intervals, by the mouth, freely diluted, small doses of morphia, and the calcium salts seem to me to have been of some benefit.

As to surgical treatment, it is not my intention to discuss the details of the operation now so well elaborated. These principles I wish to lay down:

(1) Gastrojejunostomy should be performed, but this alone is not sufficient except in cases of simple pyloric stricture.

(2) The ulcer should be dealt with, either by (a) excision; (b) infolding.

(3) Where no pyloric obstruction already exists, partial closure should be brought about by a running suture involving the sphincter muscle, so as to offer an obstacle to its free dilatation, and thus encourage the gastric contents to leave the stomach by the new opening provided for that purpose.

(4) An examination should systematically be made for a chronic inflammation of the appendix or other lesion likely to cause subsequent reflex vomiting. Any such cause should be removed. The appendix can quite easily be removed in all but exceptional cases through an incision in the right rectus, the lower end of which need not extend more than one-half to one inch below the umbilicus. This incision through the right rectus controls the gall-bladder, stomach, and appendix.

It is very surprising how frequently a chronic appendicitis has been found in my later cases where it has regularly been looked for. Thus since January, 1910, I find I have removed the appendix in 19 out of 48 cases.

In my earlier practice I was content to leave the ulcer to take care of itself and simply perform gastrojejunostomy. I am now satisfied this is not ideal surgery. Our aim should be to leave the mucous surface of the stomach as far as possible intact. It is scarcely reasonable, for example, to expect digestion to proceed normally in a stomach, part of whose posterior

wall is formed by the pancreas, and whose movements are hampered by extensive adhesions. To dissect such a stomach off the pancreas is a very difficult operation, and results in a large hole being made in the stomach, which requires to be closed like a perforation.

At first I confess I shrank from this apparently risky procedure, but now I do not hesitate to undertake it, and the result fully justifies the time, trouble, and anxiety expended.

Excision of a chronic ulcer is by no means so simple a matter as the advocates of this as a routine method would have us believe. The operation is easy and attractive in a picture where all the clamps are applied with delightful accuracy, and the subsequent line of suture leaves a beautifully shaped stomach. This is not so in actual practice, as any one with experience of these cases can testify.

Where excision gives rise to difficulty, I therefore content myself with infolding the ulcer, a proceeding which if efficiently carried out is, as I have elsewhere demonstrated (*Trans. Roy. Irish Academy of Med.*, 1901, page 142), equivalent to excision, and at the same time easier, quicker, and probably safer. The effect of infolding is to secure complete rest to the ulcerated area, though as I have elsewhere pointed out (*B. M. J.*; Sept. 30, 1908) neither excision nor infolding is an efficient operation in itself. It should therefore invariably be associated with gastrojejunostomy.

This latter operation is now so well established a procedure, the broad principles so well recognized, that it requires little comment. At the same time I know of no operation in which the subsequent comfort of the patient depends so much on little details. To these I need not here refer. One point, however, has recently been forcibly impressed upon me. I operated on a man in 1909 for pyloric carcinoma, both layers of suture were done with linen thread as is the usual practice. He made a good recovery, and resumed his work as a car driver. One year later he was readmitted to the hospital with general peritonitis, due to perforation of the large intestine by a malignant ulcer. At the autopsy we found the

gastrojejunostomy opening in perfect working order. The inner or through-and-through suture still persisted, and was hanging into the opening very much like the handle of a bucket. This is as far as I am aware the longest authenticated duration of such a suture. Such persistence is clearly undesirable, and though the absence of free HCl in the malignant stomach may possibly account for it, I have since then used fine chromicized or formalin iodine catgut for this purpose, and found it quite satisfactory.

Several cases of hour-glass stomach are included in my list. These I now always treat by a double operation—a modified gastropasty followed by gastrojejunostomy *into the lower pouch*.

In all operations the abdominal wound is closed by three or more layers of catgut suture, either formalin gut, boiled in alcohol and stored in iodine and spirit, or chromicized catgut being used. Additional support is given by two or three deep silkworm gut stitches, which, however, do not penetrate the peritoneum. Sutured in this way the abdominal wall is absolutely secure. The patient may safely be allowed up in eight to ten days.

*After-treatment.*—All cases are nursed for two days in the Fowler or sitting position. If there is any evidence of shock, which is quite rare, continuous saline is administered, after Murphy's method, for twelve or twenty-four hours. Fluids are given freely by the mouth any time after six hours from operation. Thus it is quite common for my patients to have a cup of tea the evening of their operation.

Nursed in this position and treated in this way, anæsthetic vomiting is very rare. It probably does not occur in more than 5 per cent. Nothing indeed is more striking than the rapidity and easy recovery of these cases. They are allowed soups, jellies, puddings, porridge, bread and butter, eggs, etc., from the third day, and the second week chicken, fish and even potatoes.

I have shown that the immediate mortality should not exceed 2 per cent. What about the after-progress? We have

to admit that some complications do arise and finally that a few cases, probably not more than 3 to 5 per cent., derive no benefit. The worse the condition found at operation the more striking and complete the relief. The only troublesome sequelæ in my experience are two—(a) peptic ulcer of jejunum, (b) regurgitant vomiting.

I have had three instances of jejunal ulcer. All of them were operated on before the year 1907. Of these cases two were treated by myself, by excision of the junction containing the ulcer, closure of the posterior stomach opening, and substitution of an anterior Y gastrojejunostomy. Both recovered, and have since remained well. The third, a policeman, operated on for dilated stomach in November, 1907, was admitted to hospital for perforated jejunal ulcer on December 9, 1910. Mr. Kirk operated on him successfully, and he left the hospital in good health six weeks later.

These cases were all amongst my earlier operations, where I was making a longer jejunal loop than I now do.

This complication is undoubtedly a very serious drawback to the operation, but I think by use of an inner catgut suture, and by making a very short loop, it should be practically eliminated.

Regurgitant vomiting is a very troublesome sequel. It is quite rare in the modern operation where the jejunal loop is very short—"no loop." When present is due to:

(a) Obstruction by an adhesion causing an acute kink in the descending loop of the jejunum.

(b) Reflex irritation from an appendix, ovary, or other distant cause.

(c) Persistence of former hysterical vomiting.

If due to an adhesion it may sometimes be relieved by washing out the stomach and massage. The injection of fibrolysin into the abdominal wall has appeared beneficial in two cases in which I have used it. Failing this, the cause must be removed by operation.

Now as to the permanency of cure. I am afraid it would be unwise to contend that once a person has been operated on

for gastric ulcer, perpetual immunity from all and every type of indigestion can be guaranteed. My present list is too recent to admit of any inference on this point. It has been drawn up rather with a view to establish the comparative safety and immediate benefit of the modern operation.

I have many cases, however, operated during the past eleven years who continue in perfect health. One lady operated on in 1900, after years of suffering, has since married, has a family of five children, but has remained quite free of stomach trouble. Three cases operated on by me have been accepted by three different first-class British insurance companies without any addition to the usual premium.

I venture with confidence to submit that sufferers from chronic ulcer of the stomach or duodenum, which has failed to respond to medical treatment, may confidently be recommended to consider operative treatment, the prospects being an immediate risk not exceeding 2 per cent. with 90 per cent. probability of complete and permanent cure.

# EARLY DIAGNOSIS OF CARCINOMA OF THE COLON.

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INASMUCH as a study of cancer generally is most interesting and instructive, cancer of the intestines, on account of its anatomical complications and variable symptomatology, should prove doubly so; particularly does this obtain when we take into consideration not the theory of the subject but the practical side of it, and this I will endeavor to do. The early diagnosis of any abdominal carcinoma is in many instances life-saving to the patient, in others a source of positive judgment to the surgeon or physician in the fatal prognosis. The early diagnosis of primary cancer of the liver, spleen, or pancreas is seldom positively made, because cancer in itself gives rise to no characteristic symptoms, its resulting complications being sometimes first manifested long after the beginning of the malignant process; but in carcinomata affecting the gastrointestinal tract, depending entirely upon the situation as well as the degree of the progress of the growth, the early diagnosis is in a great many instances positively determined, and the results of the early surgical attack a boon to the patient and a source of gratification to the surgeon.

The early symptoms of cancer of the colon are for a long time very indistinct and difficult of interpretation, and, apart from the anatomical site of the cancer, they depend upon three factors: first, stenosis, second, accompanying intestinal catarrh, and third, ulceration of the growth of either the mucous membrane or externally into some other organ. This last fact brings to my mind a case (J. W., aged 55 years) of carcinoma of the sigmoid that I saw about a year ago in which the patient's first symptoms were those of colitis and loss of weight and strength. It was only when distressing bladder disturbances began that he sought medical aid and



1905 to 1911. Naturally the great bulk of the volumes is from the pens of the two senior members of the staff, Drs. William J. and Charles H. Mayo. In Volume I, out of seventy-three papers, Dr. William J. is to be credited with fifteen papers, and Dr. Charles H., with twelve. In Volume II, of sixty-three papers, Dr. William J. is to be credited with twelve and Dr. Charles H. with seven. When one observes that Volume II is the output from this clinic of a single year, the growth in the activity of the work is especially noticeable.

These papers have been read before various medical societies and are brought together in their present form for convenience of reference. More than that, however, in their collected form they constitute a magnificent monument to the scope of the work carried on in the Mayo Clinic, and to the industry, breadth and progressiveness which characterize that clinic.

The volumes are published with full Indices, both of authors and of subjects, so that reference to their contents is greatly facilitated. They are abundantly illustrated.

In running through these volumes one cannot fail to feel a certain personal note significant of the relations of the directors of this clinic to their whole work. These volumes form the beginning of a personal surgery of the highest character and of the greatest value. It is to be hoped that for many years to come successive volumes of the same character will appear.

THE TREATMENT OF FRACTURES, With Notes Upon a Few Common Dislocations. By CHARLES LOCKE SCUDDER, M.D. Seventh Edition, Revised and Enlarged. Octavo. Pages 708. W. B. Saunders Company, Philadelphia, Pa., 1911.

The successive editions of this book during the past ten years have received notice from time to time in the ANNALS OF SURGERY. It has been very interesting to note the steady growth in the scope and quality of the book. Its dominant note still remains that of treatment, and the number and character of the illustrations still remain a most attractive and valuable characteristic. The author has a genius for illustration, so that in turning over the pages of the book one seems to be in the presence of the author, demonstrating the particular condition under consideration. In the present edition it is to be noted that new material has been added, especially upon fractures of the skull, fractures of the spine, fractures of the neck of the femur, and injuries to the lower end of the tibia. A chapter on

tion of the descending colon was hardened fæces. This point is important on account of the surgical attempt to relieve the pathological conditions, and the placing of the necessary incision. If a doubt exists as to the anatomical situation of this tumor, the X-ray in recent time has become a valuable adjunct to our diagnostic armamentarium, as a case which I will describe here will aptly illustrate.

Mr. P. Z., Lockport, N. Y., aged forty years; occupation, broom-maker.

*Family History.*—Gives no evidence of malignant disease.

*Previous History.*—Patient affirms that he never suffered from any illness up to the time of the present one. No infections.

*Present Illness.*—About a year ago patient began to complain of gas and pain in the right side of the abdomen; the exact localization was indefinite, but the pain was referred to the right quadrant. The bowels have been loose, and lately there has been a watery diarrhoea, and for this reason as well as for the colicky pains in his abdomen, he seeks the advice of a physician. His appetite is very good. Up to one year ago patient's digestion was perfect; he never suffered from bowel trouble until then, when he suddenly noticed this looseness. Lately he complains of a feeling of weakness and is easily fatigued upon exertion. He has lost 28 pounds during the past year. He has never passed any blood; the only difference in the nature of the alvine discharges was that they had become watery. There has been no nausea, no vomiting.

*Status Præsens.*—Patient shows a peculiar, almost yellowish, paleness of the skin and mucous membranes. He is emaciated. Conjunctivæ not icteric; tongue somewhat coated but moist. There are no palpable lymphatic glands in the neck, nor in any other part of the body. Skin lax, shows loss of fat. Lungs and heart normal. Abdomen: The abdomen is flat, no ascites; there is no visible peristalsis. On the right side, just above a line drawn through the umbilicus and below the end of the eleventh rib, is a slight elevation (Fig. 1). Palpation reveals this to be a hard, somewhat tender mass, which is irregular in outline and movable, but is not attached to the lower border of the liver. It is movable during inspiration; it can be held fixed during expiration. Bimanually, ballottement can be distinctly

FIG. 2.



Case P. Z., bismuth test, before operation.

FIG. 3.



Case P. Z., bismuth test, before operation. Plate taken fifteen minutes after FIG. 2.

hepatic flexure carcinoma. I had two X-ray plates made of the colon which I present here; it will be seen how beautifully the differential diagnosis was positively determined. In Fig. 2 will be observed the rectum, sigmoid, descending and transverse colon, and then an abrupt cessation of the shadow, as if the bowel were cut off at the hepatic flexure; it will be noticed where the cæcum should be seen are two or three fine shadows, showing a trickling of bismuth through the constricted tumor mass at the flexure.

In a second plate (Fig. 3) taken fifteen minutes after the first, will be noticed a little more distinctly shadows of the bismuth that has passed through after fifteen minutes retroperistalsis. The X-ray, as may be seen, makes very plain that we had to do with constriction of the hepatic flexure of the colon and excludes the kidney. I want to say here that a sometimes very valuable aid in the differential diagnosis of tumor of colon and kidney, that of artificial inflation of the colon, was not done because we thought it unnecessary and dangerous in this instance. Immediate operation was advised and it was done three days following the X-ray examination.

Operation at Sisters' Hospital, August 22, 1911: Upon opening the abdomen in the right semilunar line, with the middle of the incision corresponding to the level of the umbilicus, I found a hard mass about the size of a lemon which was part of the hepatic flexure of the colon. It was attached by adhesions to the posterior wall of the abdomen, but was with some difficulty freed. The cæcum, ascending colon, and a part of the transverse colon were made movable by an incision into and freeing of the parietal peritoneum and delivered. The appendix was somewhat congested, the cæcum dilated, and the ascending colon contracted to about half its length, a point which Moynihan calls attention to in his work. The ileum was divided between clamps as was also the transverse colon; the lower end of the ileum, the cæcum, the ascending colon with tumor, and part of the transverse colon were removed, as well as some enlarged glands of the mesentery. The ends of the remaining parts of the ileum and transverse colon were closed and inverted. Then a side-to-side anastomosis of the ileum with the transverse colon was made in the direction of the normal fecal current. I made the anastomosis about two and one-half inches in length, using

FIG. 2.



Case P. Z., bismuth test, before operation.

FIG. 3.

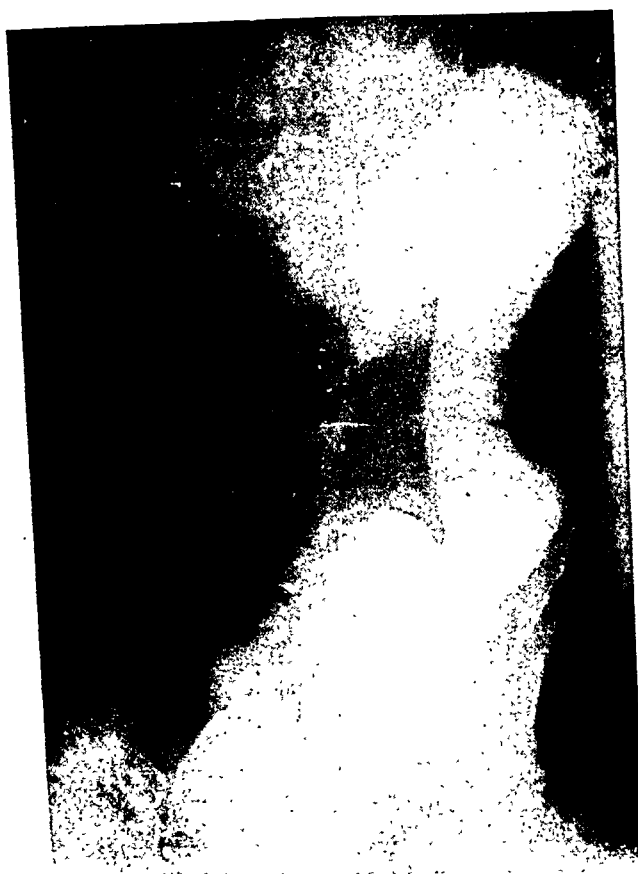


Case P. Z., bismuth test, before operation. Plate taken fifteen minutes after Fig. 2.



Case P. Z., after operation.

FIG. 5.



Case P. Z., after operation. Plate taken ten minutes later than Fig. 4.

the clamp method and Connell suture, reinforced all around with Lembert suture. After a thorough toilet of the peritoneum the wound was closed in the usual manner.

On the twentieth day after the operation, the day previous to patient leaving hospital, cured, two X-ray plates were made, to which also I wish to call attention. In this plate (Fig. 4) will be seen the bismuth-filled ascending and transverse colons, and some of the bismuth forced through the anastomosis opening into the ileum. In the plate (Fig. 5) taken ten minutes after Fig. 4, the half of the transverse colon nearer the anastomosis is seen contracted and almost empty of bismuth, while the ileum is seen to contain much more bismuth than in Fig. 4.

I wish to thank Dr. Leonard Reu for these excellent X-ray pictures.

*Differential Diagnosis.*—The differential diagnosis of cancer of the colon can best be considered by a study of the flexures, situations where the growths most frequently occur.

Beginning at the cæcum, we find two pathological conditions that can simulate carcinoma, appendicitis in old people and ileocæcal tuberculosis. There are cases of appendicitis, though very rare, that cannot be absolutely determined in the early stages, and only when an acute recurrence is present is the benign nature of the disease determined; there are others in which the differential diagnosis between cæcum carcinoma and appendicitis in the beginning gives rise to great speculation, when there exists elevation of temperature and sometimes repeated chills, as well as acute local pain. But here as well as in all cases the taking of a very careful previous history up to the time, and exact detailed symptomatology of the present illness, ought to be of great diagnostic aid. Some observers have claimed that temperature in itself speaks against carcinoma, but in this they absolutely err, because temperature elevation is a not seldom phenomenon in gastro-intestinal cancer, as Freüweiler, of Zurich, conclusively demonstrated. Fromme, of Halle, claims that this fever in cancer is due to destruction of the primary tumor, large lymph-channels being opened up, and a great amount of bacteria brought to the

lymph-glands and their toxins permeating the blood. Hence I would suggest in the differentiation of carcinoma from appendicitis in elderly people, that we pay absolutely no attention to the temperature as against carcinoma. It matters little, however, to the surgeon as both conditions demand early surgical attack, and one who opens the abdomen to operate an appendix ought to be ready to do a radical operation in case his pathology proves to be cancer. Again, as Tuffier has reported, there are cases of malignant diseases of the cæcum with abscess formation.

Since writing the above paragraph concerning the differential diagnosis of cæcum carcinoma in which fever is present as a prominent symptom, I have seen and operated on a case, the history of which I think ought to be given in detail. On account of the suddenness of the onset of abdominal pain, temperature  $103^{\circ}$ , pulse 105, and exquisite tenderness on palpation, as well as a well-defined mass in the right iliac region, a diagnosis of acute appendicitis with perityphlitis was suspected by another physician who saw the patient on the second day of the acute attack. I was invited by the attending physician to see the patient, on the twelfth day, and after going into the history of the case minutely, obtained the following data:

September 28, 1911: Mrs. C. O'B., fifty years of age, married, one child twenty-two years of age. Father died at seventy-eight of paralysis. Mother at sixty-two; cause indefinite. Patient as a child never had any infectious diseases until she was fourteen years of age, when she suffered from double quotidian malaria. Last menstruation five months ago.

*Present Illness.*—Up to one year ago she was perfectly well and able to do her household work, including washing, without fatigue. At that time and up to six months ago she noticed that she was losing weight and that she was easily fatigued in doing her work, and had to give it up. Her daughter noticed that her complexion was becoming paler and that she looked bad. About six months ago she noticed that unless she took a physic (Cascara) every day her bowels would not move. This obstinate constipation has persisted up to the present time; there has been



tumor persisted even after the cessation of the fever; (9) the clean moist tongue, which personally I have never seen in any acute abscess case; (10) and this is the most important point and the one on which I place the greatest dependence, and which as far as I am aware has not had attention called to it in the literature, namely, the fact that the skin and underlying structures of the abdominal wall over the site of the swelling could be moved by the palpating hand as if separated from, and gliding over, the tumor. I have never observed a case of abscess in the abdomen large enough to see and outline where the muscles over it were not on guard and which could be moved as above described. I did not therefore hesitate to affirm that we had to do with, not appendicitis with abscess, but carcinoma of the cæcum, a diagnosis the correctness of which was demonstrated at operation. Fever and 81 per cent. polymorphonuclear leucocytes in a count of 10,900 and still no acute abscess are observations to be considered in a negative way.

I made an incision through the middle third of the right rectus muscle, splitting the fibres. Upon opening the abdomen I found a mass about the size of two fists. The tumor proved to be a carcinoma of the cæcum. The omentum attached to the tumor mass was ligated off in sections. The tumor itself was not adherent to the surrounding structures except slightly to the posterior abdominal wall. The cæcum was delivered, the parietal peritoneum external to it was cut and freed, and the cæcum and ascending colon raised upward and toward the median line, the mesentery of the ileum and of the cæcum were ligated in sections with heavy celluloid linen. Inasmuch as the mesentery of the terminal ileum was short I removed about 14 inches of the ileum, the cæcum with mass, and ascending colon, between clamps. The end of the remaining colon I closed with a continuous suture; touched the line with carbolic acid and alcohol, and then with the Lembert continuous suture buried the stump. The end of the ileum was treated in like manner, and a side-to-side anastomosis made of the ileum with the transverse colon in an isoperistaltic direction. The anastomosis opening was about an inch and one-half in length in its interior; the omentum was sewed over the anterior suture layer of the anastomosis. The toilet of the peritoneum was made in the usual manner and the abdominal wound closed.

The post-operative history is as follows: During the first forty-eight hours patient vomited three times, complained of no pain, no bladder disturbances; the abdomen was soft, and liver dulness normal. The pulse ranged about 120, respiration 24. At the end of the second day an enema brought some gas and fecal colored water; on the third day, after a soapsuds enema, patient passed considerable flatus and some fecal colored matter. On the third day the pulse suddenly became accelerated, respirations went up to 50, lips became cyanosed, and signs of hypostatic pneumonia developed, until the fourth day, when death occurred, the cause of death being hypostatic pneumonia. A postmortem was not allowed.

I have no doubt that had I been called to attend the patient in the early days of her febrile illness, instead of on the twelfth day, I would have been deceived by the clinical picture presented, and I am sure there is no doctor who would not have suspected an acute appendicitis or a perforation of the cæcum with abscess formation, had he been called early to see the case, because we do not know definitely whether or not at that time there had been a complicating local plastic peritonitis. I do not know how to explain the reduction of the size of the mass from September 28 to October 5, as shown in these pictures, except possibly an acute plastic peritonitis existed, in the omentum, which was found adherent to growth, and absorption of the exudate took place.

In differentiating cancer from tuberculosis of the cæcum, however, most careful examination of both lung apices for healed tubercular processes, the presence of the Diazo reaction in the urine, the finding of the tubercle bacilli in the stool, and lastly the positive Von Pirquet reaction, should guide the surgeon in the right direction. There are cases of ileocæcal tuberculosis that even after removal cannot be differentiated from cancer except by careful microscopical inspection.

The differential diagnosis of hepatic flexure carcinoma we have already discussed in detail in our case report; the chief causes of error are gall-bladder and liver neoplasms, and kidney tumors.

I saw a case (Mr. C. W., sixty-three years old), however, about two months ago, that, on account of a hard painful mass about at the hepatic flexure, the thought of carcinoma of that part was taken into consideration, because the patient had lost considerable weight within a short period, was obstinately constipated, and complained of colicky pains and gas in the abdomen; but from the fact that he was jaundiced somewhat, that the tumor could not be separated from the liver and was not movable, that years before he had had an attack of what I judge was acute biliary colic, I made a diagnosis of gall-stone disease with Riedel's lobe; operation revealed impacted cystic duct stone, a Riedel's lobe, and the mass which I misinterpreted was omentum which was infiltrated, attached to and enveloped the gall-bladder and lower border of the liver.

Carcinoma of the transverse colon is so exceedingly rare that confusion with gastric carcinoma of the greater curvature is of seldom occurrence. The gastric symptoms, such as coffee-grounds vomit, the Boas-Oppler bacilli, and the absence of free HCl, and the presence of lactic acid in the stomach contents, need only to be mentioned to differentiate it from stomach cancer; then too the X-ray ought to be an aid, as a case I shall briefly mention will illustrate.

The patient (Mrs. M., forty-five years of age) complained of great loss of weight and rapidly diminishing strength, and a somewhat painful lump about the size of a lemon which appeared in the middle line of the abdomen just above the umbilicus. She complained of no gastric symptoms. On account of the mobility of the tumor mass and the constipation which was present, the idea that possibly a transverse colon carcinoma existed was thought of. The X-ray pictures showed definitely a greater curvature carcinoma and normal colon.

Of course there are cases of carcinoma of the transverse colon that rupture into the stomach and give rise to fecal vomiting, but with the diagnosis of such a condition, inasmuch as it concerns an advanced stage of the disease, we have in this paper nothing to do.

Carcinoma of the splenic flexure I have never personally observed, but Schmidt says the only conditions that can be mistaken for it are carcinoma of the stomach and of the spleen. Here again the X-ray should prove of great assistance.

In malignant disease of the sigmoid where the early pains are referred to the bladder and left testicle, the error of confounding it with nephrolithiasis can obviously be made; but the absence of pathological urinary changes, blood, pus, etc., the negative X-ray findings as regards stone in kidney or ureter, would exclude kidney colic at once.

In this paper I have endeavored to confine myself strictly to the practical side of the early recognition of colon cancer, and if I have digressed somewhat with the recitation of personal cases, it has been with the innocent intention to avoid theoretical discussion and quotations from authorities so called, and to give the results of my own clinical observation.

# NON-TRAUMATIC LARGE HEMORRHAGE INTO THE KIDNEY SUBSTANCE OR ITS SURROUNDINGS.

BY RUSSELL STORY FOWLER, M.D.,

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HEMORRHAGE into the kidney substance or in the neighborhood of the kidney commonly follows trauma; but *spontaneous hemorrhage* is so rare as to constitute a surgical curiosity. The etiology of such hemorrhage is found to reside in an arteriosclerotic condition of the kidney, as in Doll's second case; in acute nephritis, as in a case reported by W. H. Dickinson of congestive nephritis resulting from exposure, in which at the autopsy each kidney was found imbedded in a mass of coagulated blood which lay outside the capsule in the surrounding cellular tissue; the hemorrhage was caused by a rupture of the capsule from congestive swelling of the kidney. Rupture in each kidney was at the inferior portion. A tumor of the kidney may cause hemorrhage, as in the case operated by Tuffier, a man of forty who had a hemorrhage into the right kidney from a round-celled sarcoma of the kidney. The case terminated fatally. A fourth cause is found in rupture of an aneurism of the renal artery or one of its branches either before entering the kidney or into the kidney substance. In the *Philadelphia Medical Journal*, May 5, 1900, Keen reported a case of aneurism of the renal artery and gave a résumé of twelve other cases: Titius (S. C.), Gossett, Leudet, Danner, Catalog Museum St. Barth. Hosp., London, 1882, i, 234, Specimen 1636, Armstrong, Turner, Hochenegg, Oestrich (two cases), Grüber, Hahn. Morris, in *The Lancet*, October 6, 1900, reported twenty cases (Hilton, Morris, Rouppe, Danyau, Mounier, Murray, Dourlin) and the thirteen cited in Keen's paper. The case in Morris's paper known as the Reeves case is the same as the Turner case in Keen's paper. The Titius case in Keen's paper seems to be a reference to Nebel's case, the better history being in

Morris' paper. Skillern in the *Journal of the American Medical Association*, January 6, 1906, was able to add five cases (Deaver, Fulton, Abbott, Barnard's first case, and Barnard's second case). Since Skillern's paper but one new case has occurred—Markley, *Medical Council*, Philadelphia, 1909, iv, 225.<sup>1</sup>

Of these 26 cases (Keen, Gossett, Oestrich, two cases, Nebel, Armstrong, Markley, Turner, Hochenegg, Grüber, Hahn, Hilton, Morris, Rouppe, Danyau, Mounier, Deaver, Leudet, Danner, Museum Specimen, Abbott, Barnard, two cases, Murray, Fulton, Dourlin) six (Leudet, Danner, Museum Specimen, Oestrich, Abbott, Barnard) gave no symptoms traceable to aneurism, the aneurism being discovered at autopsy; three of these cases (Murray, Fulton, and Barnard's second case) are not completely enough reported to be of value. Ten cases (Turner, Hochenegg, Grüber, Hahn, Hilton, Morris, Rouppe, Danyau, Mounier, Deaver) show hemorrhage into the kidney immediately following severe injury, with recorded kidney symptoms at the time of injury and followed later by traumatic aneurism. In addition are five cases (Keen, Gossett, Dourlin, Armstrong, Markley), in which there was no history of traumatism and in which rupture occurred, which have sufficient data to be of clinical value. In the remaining two cases (Oestrich, Nebel) it is doubtful whether or not traumatism entered as a factor.

A synopsis of Markley's case is as follows:

*History.*—Male, aged seventy years, pain in the left inguinal region with enlargement of the spermatic cord. First pain had been in the left testicle. Pain increasing. Had had two or three attacks of gravel (?). Pain became rapidly worse. On the second day severe pains in the entire left side. Third day sudden excruciating pain with collapse. Pain over region of the kidney. Died four hours later. Autopsy showed aneurism of the renal artery just outside the kidney, with a deep convexity on the anterior surface of the kidney from pressure. The aneurism extended from the internal inguinal ring almost to the diaphragm.

September 19, 1909, there was referred to me a case which at operation proved to be one of spontaneous bleeding into

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<sup>1</sup>There has been some question as to the total number of cases reported, Skillern giving the total number of cases as 27 in 1906.

the kidney substance, without any history of injury. The history of the case given below shows that there had been three attacks of lumbar pain similar to the one with which she suffered when referred to me, extending over a period of twenty years. The pathological condition found at operation was so unusual and the clinical picture so striking that no term seemed better to describe the condition than that of apoplexy of the kidney.

T. G., female, aged fifty-two, quite stout, was referred to me September 19, 1909, by Dr. Licht with the following history: Ten days before her admission she had noticed a slight dull pain in the back, which four days later became more severe; she then noticed considerable blood in the urine and several clots. Urination was accompanied by sharp cutting pain in the left lumbar region, radiating to the front of the abdomen and downward to the pelvis. Urination occurred three or four times daily, and the patient was not obliged to get up at night. The cutting pain in the back was worse at night. There was a chill followed by fever. Three days before admission there had been three attacks of vomiting. On the morning of admission the pain became localized to the left lumbar region, and there was considerable tenderness in that region.

The patient gave a history of having had a severe malaria twenty-five years before, lasting for two and a half years. She had had three attacks of lumbar pain similar to the present one, the first 20 years ago, the second 5 years later, and the third 6 years before the present attack. The third attack was the most severe. The history was in other respects negative.

Examination showed a tender, immovable tumor the size of a cocoanut occupying the site of the left kidney. The mass was plainly visible as well as palpable. Temperature, 98°; pulse, 104; respiration, 24. Urinalysis: specific gravity, 1025; color, red; reaction, acid; albumin, a trace; urea, 19 gr. to the ounce; microscopical, an abundance of red and white blood-cells; some hyaline casts; quantity, 45 ounces. Blood examination: hæmoglobin, 95 per cent.; leucocytes, 7800; differential, 75 per cent. X-ray examination negative, no stone discoverable. Permission could not be obtained for a cystoscopic examination, and the patient demanded immediate relief.

Although no history could be obtained of the sudden passage of a large quantity of urine following relief of the pain, and although the X-ray did not show a stone, it was thought probable that the case was one of hydronephrosis associated with calculus. Operation, however, disclosed a very different condition. A six-inch incision in the lumbar region was carried down through the transversalis fascia, and the kidney fat exposed. Immediately on opening the transversalis fascia there was a gush of a small quantity of fluid blood. This was sponged away, and a number of clots, about a double handful, removed from the kidney fat. The kidney fat was separated down to the kidney and the kidney brought up into the incision. There was considerable free bleeding. With the first and second fingers of the left hand pressing the pedicle of the kidney, the organ was examined. It was found that there was a rent in the capsule and in this rent a large clot shaped to the kidney. On account of the hemorrhage it was deemed wise to do a nephrectomy. The tissues surrounding the renal artery and vein were somewhat oedematous, the pedicle was ligated *en masse* with braided catgut. The kidney was removed, the wound cleansed from fluid blood and clots, and as there was some oozing from torn adhesions in the neighborhood of the diaphragm, the entire wound was packed tightly, the end of the packing being led out of the lower angle of the wound. The wound was then closed, except for its lower angle, with layer sutures. The packing was removed on the fourth day and a small strip reinserted, the wound healing *per primam* except at the point of the emergence of the packing. This granulated rapidly. The patient was out of bed on the twelfth day and went home on the eighteenth day. The one untoward symptom noted was some bladder irritation from concentration of the urine; this was remedied by the ingestion of large quantities of fluids and alkalis.

The kidney presents the following appearance: a tear in the capsule through which there had escaped a considerable amount of blood; a partially organized clot beneath the capsule, which had dissected the capsule on the convexity of the kidney loose from the cortex; this shows that the hemorrhage had extended through the rupture of the capsule; a small rupture at the lower pole of the cortex, through which the blood had escaped from the kidney structure; a cavity the size of an egg in the cortex filled with fresh blood-clot; a few small clots in the pelvis of the kidney and in the upper part of the ureter. This, as well



as the presence of blood in the urine, showed that there had been some connection between the hemorrhage in the cortex and the pelvis. Such an opening, however, cannot be made out in the specimen. Dr. Arthur C. Holzman reports the microscopical examination as follows: (1) Section taken from upper pole of kidney away from the blood-clot shows no apparent change in the kidney structure. (2) Section bordering on blood-clot shows, first, the blood-clot, and bordering this, the broken-down structure of the kidney. Passing away from the clot, the normal structure of the kidney is perceived in a state of molecular necrosis apparently from pressure. Here the renal tubules are filled with blood and widely distended, others are collapsed from the pressure of the distended tubules. Still further externally is a zone of tissue, where renal tissue is unchanged except for the tubules which are enormously distended with blood, which passes off into normal renal structure. Nowhere is there an infiltration of round cells or fibrous tissue. The red blood-cells retain their form and are not broken down. (3) Section of blood-vessel (vein entering cavity) shows an atrophy of the coats. Otherwise no change.

## ABSTRACTS OF OTHER REPORTED CASES.

In 1910 Dr. PAUL PICK described a case operated upon March, 1909, by Schnitzler. Schnitzler's case was that of a woman of fifty-three, who, during the menopause, had had violent hemorrhages. Eight years previously she had had an attack of illness with jaundice lasting four weeks, accompanied with violent pains on the right side of the abdomen. For a number of years she had been constipated. A few days before coming to operation, she had become suddenly attacked with violent pains in the right side of the abdomen. These pains were so severe that she became unconscious; she had since had continuous pain. There was no vomiting; the bowels had last moved four days before. Temperature  $37.2^{\circ}$ ; pulse 72. The patient was of medium size, rather corpulent, of pale complexion. There was slight jaundice. The right side of the abdomen was somewhat distended. Percussion gave normal resonance over the spleen and stomach. Palpation revealed a somewhat enlarged liver; there was marked sensitiveness over the liver; this sensitiveness was more extreme in the right mammillary line below the liver, where there was also felt a resistance. Urinalysis was negative. A clinical diagnosis of cholecystitis was made. An incision over the region of the gall-bladder showed a firmly distended gall-bladder about as large as a child's head, but with no trace of recent inflammation or gall-stones. Exploring further it was found there was an extensive hæmatoma beneath the mesocolon and in the retroperitoneal connective tissue; the abdominal wound was sutured and an incision made in the flank for exploration of the kidney. Upon separating the fatty capsule there was found a large clot surrounding the kidney on all sides. After removal of the clot the kidney seemed quite normal. The origin of the bleeding could not be established. The after course was uneventful except for rather severe infection, necessitating a counter-incision. The patient finally left the hospital cured. Pick makes reference to seven

other cases of a somewhat similar nature. The first reference to the subject is that of Wunderlich in 1856. Wunderlich included in the term "apoplexy of the renal covering," every hemorrhage in the neighborhood of the kidney.

HILDEBRANDT, in 1894, published the first case of perirenal hæmatoma; his case gave the following history: Female, nineteen years old, was suddenly attacked three weeks before with violent pains in the left side of the abdomen. There was considerable shock. The abdomen was greatly distended, and on the left side there was a firm elastic tumor projecting under the costal arch as far as the navel. There was no fever; urine was normal. On incision  $1\frac{1}{2}$  quarts of blood and blood-clots escaped. This hæmatoma had completely surrounded the left kidney, which, upon examination, proved quite normal. The wound was drained and the patient was discharged cured after eleven weeks.

DOLL, in 1907, under the name of "Apoplexy of the Renal Covering," describes two cases, both of which resulted fatally without operation. The first case, a man sixty years old, with advanced arteriosclerosis and chronic nephritis, was attacked with colic-like pain in the left kidney region. On the third day of his illness left pleuropneumonia supervened; on the fourth day there was observed an extreme distention of the abdomen, with a large tumor in the left side of the abdomen; on the fifth day the skin in the left lumbar region and the left half of the scrotum became blue; a few hours later the patient died. At autopsy there was found a retroperitoneal hæmatoma reaching from the diaphragm to the bladder; the hæmatoma consisted alternately of masses of fatty matter and blood-clot. Doll's second case was a man forty-one years old, also with arteriosclerosis and chronic nephritis, who was attacked with paroxysmal colic-like pains extending over the entire left side of the abdomen; on the second day a firm elastic tumor was noted in the left side of the abdomen; the patient seemed anæmic; on the fourth and fifth days there was great distention, and the skin over the left renal region became livid; the underlying parts were doughy to the touch. On the fifth day the patient died. Autopsy showed an intra-peritoneal hæmatoma lying between the descending colon and wall of the abdomen, and connecting with a retroperitoneal hæmatoma, consisting of fatty matter and blood-clot extending from the diaphragm to the bladder; in the centre of this mass was found a small white kidney *in the capsule of which there was found on the upper pole a small tear*. This led to a small cavity which, as was proven microscopically, consisted of arteriosclerotic kidney tissue.

In 1908 JOSEPH reported a case of spontaneous hemorrhage into the kidney substance, the patient a man of fifty years who had suffered for years with gout. He was taken ill with violent pains in the right side of the abdomen; some days later there was fever and an undefined resistance on the right side of the abdomen; extreme distention followed; the skin overlying the right lumbar region became blue on the sixth day. One year before the patient had had an operation for appendicitis; for this reason a diagnosis of retroperitoneal suppuration due to further trouble with the appendix was made; the patient was operated upon on

the twelfth day. An incision was made in the kidney region and the fatty capsule was removed; septic pneumonia followed and ten days later the right kidney was removed, it being thought that this was the starting point of the sepsis; the following day the patient died. This report lacks adequate pathological description.

Two other cases are reported by LENK as occurring in Hochenegg's clinic. The first that of a girl twenty years old, who was suddenly taken ill with violent pains in the right side of the abdomen; on the sixth day of her illness she was removed to the hospital, and it was noted that she was quite anæmic; the abdomen was distended, there was an ill-defined swelling in the right hypogastrium; urine was normal. Diagnosis of retroperitoneal abscess originating in the appendix was made, and the patient operated upon immediately. A retrocæcal tumor was incised and found to consist of coagulated blood; the cavity extended upward behind the liver. This patient died four days later with septic symptoms. The second case was a woman twenty-eight years old, who had suffered for two years with attacks of pain in the right side of the abdomen; she presented a clearly palpable tumor in the right lower region of the abdomen. Hochenegg removed the fatty capsule, in which were numerous slight hemorrhages, and subsequently demonstrated with the cystoscope and ureter catheterization a hydronephrosis of the right kidney with pronounced impairment of function. This patient left the hospital cured.

It will be noted in remembering the history of these cases of hemorrhage into the renal substance exclusive of aneurism, that with the exception of Doll's second case and the writer's there is no reference made to any communication existing between hemorrhage in the interior of the kidney and hemorrhage into the fatty capsule. In fact, in several of the cases it is noted that the kidney appeared normal (Hildebrandt, Schnitzler), and that the hemorrhage surrounded the kidney. I believe we can therefore say that we have to do with *two pathological conditions*: one arising within the kidney, and later through rupture of the capsule propria involving the tissues around the kidney; the other arising in the fatty capsule of the kidney. Either of these forms may later become so extensive as to rupture the peritoneum and involve the peritoneal cavity. Such hemorrhages as the latter are occasionally seen in fatty tissues of other parts of the body in corpulent people; they follow slight exertion, such as a sudden twist or strain on the part, and have been known to occur when the patient turned over in bed. As an example of this condition of hemorrhage into fatty tissues may be cited

the case of a patient referred to me by the late Dr. J. F. Haller. This patient, an extremely stout man, had been seized with sudden pain over the region of the gall-bladder while turning over in bed; his pain and shock were so intense as to cause a diagnosis of cholelithiasis to be made; when he came under my observation some four or five days later, there was a lack of fever or of any constitutional disturbance. There was, however, a tumor in the abdominal wall overlying the gall-bladder and hepatic flexure of the colon; this mass was ovoid, about the size of the palm, and rather dense; an exploratory incision revealed it to be a rupture of several of the radicles of the epigastric veins, resulting in a hæmatoma. Healing was uneventful.

*Symptomatology.*—Excluding the cases of aneurism, Tuffier's case of sarcoma and Armstrong's case of congestive nephritis, there remain eight cases (Hildebrandt, Doll's two cases, Joseph, Lenk's two cases, Schnitzler and Fowler) having sufficient data to be of value. Spontaneous hemorrhage either in or about the kidney has occurred three times in males and five times in females; in four cases of young adult life, in three cases of middle age, and one case in old age. It has been associated with jaundice once, with arteriosclerosis and chronic nephritis twice, with gout once, without other diseases four times. In no case was any history of traumatism obtained. In two cases the history definitely states that the patient was fat. The onset of the attack was sudden in all cases, the character of the pain was agonizing in six cases, was less acute in two cases (Hochenegg's second case and the author's case). In all the cases the location of the pain was referred to the half of the abdomen corresponding to the kidney affected. One case gave urinary symptoms—the author's case in which there was sharp, cutting pain in the left lumbar region radiating to the front of the abdomen and down to the pelvis accompanying urination. There was also blood in the urine in this case. In three cases the urine was stated to be normal. In one case there was impairment of function of the kidney affected. In one a mild nephritis; in two a chronic nephritis; in one the urinalysis is not stated.

Shock was a prominent initial symptom in most of the cases though not definitely stated in some cases.

The final location of the pain where mentioned in the history was referred to the lumbar region. Tumor was present in all the cases, though in three it was not well defined, and in one of these latter diagnosis of the location of the swelling was further confused by a much distended gall-bladder.

Extreme abdominal distention is noted in five cases, one not noted, one with slight distention, one no distention.

Anæmia was present in four cases, not present in one case, and not noted in three cases.

Local discoloration of the skin was noted in three cases, absent in five.

Location of the tumor: On the left side below the costal arch, one case; on the left side of the abdomen, left lumbar region and left half of the scrotum, one case; left half of the abdomen and left renal region, one case; right side of the abdomen and right lumbar region, one case; right hypogastrium, one case; right lower region of the abdomen, one case; right upper side of the abdomen, one case; left renal region, one case.

Fever was present in four cases, absent in one case, not noted in three cases. Even where present it was not a prominent symptom before operation.

The symptoms vary according to the severity of the hemorrhage. The course of the attack varies from two days to twenty-six days. In the unoperated fatal cases the course of the attack was five days. There may be slight repeated hemorrhages, as in Hochenegg's second case, or more severe repeated hemorrhages, as in the author's case, extending over a period of from two to twenty years.

*Diagnosis.*—The diagnosis of hemorrhage into the kidney substance or into the perinephritic fat is difficult if not impossible. Of the cases which we are considering, one was diagnosed as cholecystitis; in two cases exploratory incision was made; no diagnosis in two cases; retroperitoneal abscess from appendicitis in two cases; hydronephrosis associated with

calculus in one case. It is a concomitant symptom of shock or shows interference by pressure on the intestinal nerves.

Urinary symptoms are of no aid except as excluding other lesions of the kidney. In only one case was blood found in the urine.

The diagnosis, if made at all, must be made upon the occurrence of sudden pain in the renal region, associated with tumor and more or less shock, and must be supported by the exclusion of other lesions of the kidney.

*Treatment.*—Of the eight cases reported six were operated upon, of whom four recovered and two died, a mortality of  $33\frac{1}{3}$  per cent. The two cases not operated upon both died.

The technic of the operative treatment will depend on the pathological condition found at the operation. If bleeding is limited to the perirenal fat, this must be excised completely, the hæmatoma removed, and adequate drainage provided. If, however, the bleeding proceeds from the interior of the kidney and has later involved the perirenal fat, not only must the perirenal fat and hæmatoma be removed but a nephrectomy done as well. Thorough removal of the fatty tissues infiltrated with blood-clot is essential, as the post-operative history of these cases shows that suppuration easily follows.

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# THE OPERATIVE TREATMENT OF THE DEFORMITY OF POTT'S DISEASE.\*

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THE treatment of Pott's disease after the general acceptance of the principles of mechanical support, as demonstrated by Taylor and Sayre, had become practically one of routine, when in 1897 fresh interest was aroused by Calot's advocacy of forcible correction of the deformity.

This, although an ancient practice, and although it had been performed in a fashion by Chipault several years before, was, as far as its practical application was concerned, a new operation. After a very general test it was abandoned, not so much because of its dangers as because it had been demonstrated by autopsy and confirmed by experience that the capacity for bone formation between the separated vertebral bodies was quite inadequate to fill the gap caused by straightening the spine. Thus recurrence of deformity was not only inevitable, but necessary even for repair.

Calot's operation served an important purpose in calling attention to the ineffectiveness of routine treatment, and, although forcible correction was abandoned, greater effort has been made since this time to reduce deformity by milder means and to remove pressure and friction, the most constant factors in the destructive process, by extension and hyperextension of the spine.

My own contribution has been the narrow convex frame designed to correct deformity by gravity, and to hold the spine in hyperextension during the active stage of the disease. This is, in popular speech, the "board" which the photographs of Smiling Jimmy of the Sea Breeze Hospital have made familiar.

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For ambulatory treatment Tunstall Taylor, Goldthwait and others devised apparatus to apply jackets in dorsal recumbency, while Calot, in his persistent efforts to reduce deformity, made a still more important modification of the plaster support. Better fixation was assured by including the shoulders, neck, and, if necessary, the head, while corrective force was provided by pressure over the kyphosis, the front being cut away to permit the protrusion of the chest as the trunk was pushed forward. Calot has presented photographs showing recession of marked deformity, and although this is unusual, it must be admitted that the Calot jacket is far more effective than ordinary supports, requiring, however, more skill in its application and more careful supervision to make it tolerable.

While it may be stated that, under favorable conditions, by the use of simple means such as the convex frame in recumbency and the Calot jacket in ambulation, deformity may be prevented and even in some degree lessened; on the other hand it must be admitted that, at best, mechanical treatment is tedious and difficult; and that it is ineffective under ordinary circumstances is evidenced by the number of noticeable deformities from this cause, the degree being determined rather by the character and situation of the disease than by the means used to prevent it.

For example, the cervical and lumbar or free regions of the spine are favorable for treatment, and, in the absence of complications, recovery without noticeable deformity may be anticipated. In the thoracic region, on the other hand, the opportunity for deformity is great, and the constant movement of the thorax in respiration makes it difficult to assure the rest essential to repair.

Repair in milder cases is sometimes accomplished by adhesion of the adjoining vertebral bodies, but ordinarily the loss of substance is so great that symmetrical apposition is impossible. In this class of cases final consolidation is sometimes assured by a callus formation, which involves the lateral



masses and even the laminæ and spinous processes remote from the disease.

The object of operative treatment is to induce such consolidation of the posterior part of the spine, in order that it may serve as an effective splint to prevent deformity and to assure the rest that permits repair.

The first operation for this purpose was, it would appear, suggested by Hadra (*Trans. American Ortho. Assn.*, vol. iii, 1891). He proposed to bind the spinous processes of the diseased and adjoining healthy vertebræ to one another by silver wire twisted in figure-of-eight turns, a procedure which had been successfully employed by him in a case of fracture.

A similar and more comprehensive operation, in that deformity was first corrected and the adjacent spinous processes denuded and afterward bound to one another by silver wire, was later described by Chipault in 1893.

Recently F. Lange, observing the toleration of the tissues for silk, metal, and other foreign substances, has attempted to replace external support by internal splints, which being independent of the patient's control should be more efficient. He found tin plated steel to be the best material, and in the one successful case which he reports in detail the procedure was in brief as follows: The splints were of tin plated wire, 10 cm. long and 5 mm. in thickness. Incisions were made through the skin and fascia, corresponding to the upper and lower ends of the splints, which were then inserted beneath the muscles close to the spinous processes, on either side of the diseased vertebræ, the bulbous extremities being attached to the spinous processes by silk to retain them in position. A Calot jacket was applied with an opening to prevent pressure. This was replaced in six weeks by a celluloid corset worn constantly for six months, when, the patient being free from pain, it was gradually discontinued.

The operation was performed about two years before it was reported in 1910 (*Journal American Ortho. Assn.*, Nov., 1910). The patient was a boy about twelve years of age, the disease at about the tenth dorsal vertebra. Pain was immedi-

ately relieved and the progress of the deformity was checked. After the support was discarded the boy served as a helper to a blacksmith. The metal splints remained in position, holding the diseased section of the spine securely. Lange considered the transplantation of bone, but because of the additional injury to the patient in autoplasmic transplantation and because of the difficulty of obtaining suitable material from other subjects at the proper time, he preferred to experiment with metallic supports.

Another form of operation on the lines of that of Chi-pault, but in a more effective form, has been described by R. A. Hibbs, the design being to induce adhesions between the spinous processes and at the same time to lessen the prominence of the kyphosis (*N. Y. Med. Jour.*, May 27, 1911). An incision is made along the spinous processes, the interspinous ligament is split and separated with the periosteum to either side. With a chisel the base of the spinous process of the sound vertebra above the diseased area is cut through, and the operation is repeated on the spinous processes involved in the disease, including finally the sound one at the base. Each spinous process is then displaced and tilted downward so that, while a part of its base is still in apposition with the surface from which it has been displaced, its tip is brought into contact with the upper part of the area from which the spinous process of the vertebra below has been separated. The tissues are then sewed over the fragments and a support is applied.

This operation was first performed on December 27, 1910, and has been repeated on two other patients. In the first case an X-ray picture taken three months after the operation shows consolidation of four spinous processes, the disease being at the second lumbar vertebra. All support had been removed on April 5 or about three months after the operation. Hibbs suggests that supplemental bone grafting from the tibia might be necessary to secure consolidation in younger subjects.

In an article appearing recently (*Jour. Amer. Med. Assn.*,

Sept. 9, 1911), F. H. Albee reports three cases in which bone taken from the tibia was transplanted to one side of the spine. The spinous processes overlying the disease were split longitudinally to the lateral side of the centre. The lesser section was separated laterally, leaving a wedge-shaped interval into which the bone graft was placed. The first operation was on June 11, 1911, the last on July 14. The report was apparently made soon after, consequently no further details, except that primary union was obtained, are given.

In considering operative treatment it has seemed to me that it should be especially indicated in early cases of disease in the thoracic region, in which the deformity might be easily corrected with but slight separation of the vertebral bodies; that Lange's method was mechanically the best, but that the metal splints should be replaced by bone of sufficient strength to serve as an immediate support, and which in process of absorption might stimulate a callus formation from the neighboring parts similar to that found in the natural cure.

The patient who first offered a favorable opportunity for a test of the treatment was a boy nine years of age, who was admitted to the hospital because of a pressure sore caused by a plaster jacket. The disease was progressive as evidenced by pain, muscular spasm, and lateral distortion of the body. There was a moderate degree of angular deformity, which was sufficiently flexible as to indicate that there had been no progress toward repair.

On August 11, 1911, the ulcer over the kyphosis being closed, the operation was made as follows: The entire length of the crest of the tibia was exposed, and a thick, strong section of its anterior part, six to seven inches in length, was separated with the chisel. This retained the periosteum intact on its upper surface and the endosteum on its lower, the medullary cavity of the bone being completely exposed. The tibialis anticus muscle was drawn over the gap, the skin was sutured, and a plaster bandage was applied.

An incision about four inches long was made a little to the right of the median line over the diseased area, and the muscles

were separated on either side from the spinous processes and lateral masses, the tissue was removed from between the spinous processes, and the bony surfaces in the neighborhood freshened. The tibial bone was then cut into two equal parts, and the spine having been forcibly straightened, these were inserted by the side of the spinous processes with the periosteal surface uppermost. The muscles were sewed over the grafts and the wound was closed. A Calot jacket was applied and to its contour a convex stretcher frame was adjusted.

The patient, after an uneventful period of five weeks, died six weeks after the operation, apparently of tuberculous meningitis. This complication is relatively so common in all forms of tuberculous disease in children, according to the statistics of this hospital no more so in those who have been subjected to operation than in those who have not, that it is impossible to say whether or not the treatment hastened the outcome. Unfortunately, no autopsy or even examination was permitted. All wounds were closed and the bone grafts were firmly fixed, supporting the spine in the corrected position.

In the literature of the subject but two positive observations appear: (1) that in Lange's case metal splints were tolerated for a period of two years, and that they served the purpose for which they were used; (2) that in one of the cases reported by Hibbs, ankylosis between the spinous processes of the lumbar vertebræ was secured, and that this union was sufficient to support the spine. Furthermore, it is sufficiently established that the tissues will tolerate transplanted bone, which may serve a temporary purpose as a support and, in the process of absorption, stimulate the reproduction of bone from the adjacent tissues.

Bone transplantation from the same individual is usually more successful than from other subjects. Grafts are usually taken from the tibia for obvious reasons. Possibly sections from the ribs, as suggested by Dobrotworski (*Zeits. f. Chir.*, Aug. 12, 1911), might be equally serviceable.

As has been suggested, the operation seems to be especially indicated in disease of the thoracic region in which the

deformity may be easily corrected. In this class of cases the tissues are so thin that the bone splints should be buried beneath the muscles to avoid the danger of pressure necrosis.

The procedure followed by Albee does not appeal to me, as the implanted bone is too superficial and is unsymmetrically placed.

Hibb's operation, which lessens the direct deformity and which has, in the reported case, induced ankylosis, might be with advantage combined with transplantation.

At the present time operative treatment is in the experimental stage, and its actual value can be determined only by years of observation. This point of view and the exigency of this occasion will excuse the inconclusive report that has been presented.